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ABSTRACT

This report summarizes activities and findings of a federally funded center at the Arkansas Children's Hospital which reviewed and disseminated literature on the identification and assessment of children with attention deficit disorders (ADD). Meetings throughout Arkansas led to the identification of interest areas, and findings are summarized for the following: (1) history of the ADD concept and its relation to attention deficit hyperactivity disorder and to the earlier minimal brain dysfunction construct; (2) different definitions of ADD; (3) epidemiology or incidence of ADD and how it varies as a function of types of surveys, definitions, and groups studied; (4) etiology or probable causes of ADD, considering both environmental and genetic causes and their interaction; (5) conditions co-occurring with ADD (such as oppositional/defiant, conduct, anxiety, and mood disorders); (6) biological associates of ADD, such as biochemical and neurological abnormalities, as objective bases for placing children on medication; (7) experimental psychological approaches to the study of ADD, including support for the assumption that the basic problems are hyperactivity, inattention, and impulsivity; (8) rating scales that reliably assess ADD; (9) structured interviews that can be administered by lay persons or professionals and their value in diagnosis; and (10) psychoeducational, neuropsychological, and neurological assessment methods. (Contains approximately 600 references.) (DB)

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ASSESSMENT AND CHARACTERISTICS OF CHILDREN WITH ATTENTION DEFICIT DISORDER

Education of Children with Attention Deficit Disorder

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ASSESSMENT AND CHARACTERISTICS OF CHILDREN WITH ATTENTION DEFICIT DISORDER

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Division of Innovation and Development
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ASSESSMENT AND CHARACTERISTICS OF CHILDREN WITH ATTENTION DEFICIT DISORDER

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FOREWORD

In 1990, several members of Congress raised the issue of whether the term Attention deficit Disorder (ADD) should be listed as a separate handicapping condition under Part B of the Individuals with Disabilities Education Act (IDEA). Certain educational organizations, including the Council for Exceptional Children (CEC), opposed this, arguing that these children could be served under existing categories of learning disability, serious emotional disturbance, and other health impairment. It was thought that the addition of ADD "would be counterproductive because of a lack of professional consensus regarding definition and diagnostic criteria" (p. 1, CEC publication). For those of us who have approached the definition of ADD from a medical/psychiatric point of view, the statement of CEC was rather surprising, since ADD was about as well defined in DSM-III as any other condition.

In any event, this controversy led Congress to require the Department of Education to establish four centers to obtain input from the field and disseminate information. Of the four centers, two were funded by the Department of Education to review and disseminate literature pertinent to the assessment and identification of children with ADD, and two were funded to do the same for intervention and treatment.

In September of 1991, the Department of Education issued a memorandum stating that a child with ADD may qualify for special education and related services under Part B of IDEA via the category of "Other Health Impaired" providing ADD is a chronic or acute health problem that results in limited alertness, which adversely affects educational performance. The Department of Education memorandum recognized the overlap with other disorders and said that children with ADD are also eligible when they satisfy criteria applicable to other disabilities such as learning disability or serious emotional disturbance. Failure to pay attention is thought of as a learning problem by some teachers. While the application of statistical criteria enables us to identify more extreme and more homogenous subgroups of learning disabled children, these more rigorous criteria may fail to identify many children who need special services because of learning problems. The great majority of ADD children have serious learning problems in the sense on an inability to meet the demands of the school.

Moreover, under Part B of IDEA, the requirements of Section 504 of the Vocational Rehabilitation Act of 1973 state that the school must conduct an evaluation to determine whether a child is "handicapped" as defined by law. If a child has a physical or mental impairment that substantially limits a major life activity (e.g. learning), then a local educational agency (LEA) must make an individualized determination of the child's educational needs for regular or special education or related aids or services. Section 504 also states that child's education must be provided in a regular classroom, unless it is shown that education in the regular school room, with the use of supplementary aids and services, cannot be achieved satisfactorily. This implies that local schools are responsible for the assessment of children with ADD, which is expensive whether done by school personnel or persons hired

by the school district. It is obviously important to assess ADD reliably as early as possible in the life of the child, and particularly during the early school years, inasmuch as school failure can lead to psychological maladjustment in susceptible children.

We were one of the two centers established to review the assessment literature, and this document is a result of that effort. We had the help of a great number of people, and especially wish to thank Jane Hauser in the Department of Education, Tom Nosal for handling our local dissemination, and Caroline Proctor for her help with our work in the Delta Region. We also wish to express our appreciation to external reviewers, Drs. Russell Barkley and Benjamin B. Lahey, who made many valuable suggestions.

1.0 Description of operations to date.

As outlined in our original application, we first organized three meetings in Arkansas: one in a relatively poor rural and agricultural area, called the Delta Region, and two in the metropolitan area of Little Rock. The purpose of these meetings was to develop a list of critical issues (unanswered questions, areas of ignorance, and topics that parents, teachers, and clinicians wished to learn more about). All three meetings involved parents of ADD/ADHD children, school teachers, school administrators, school psychologists, and family physicians. The participants in Little Rock included more specialized personnel--Head of Child Psychiatry at the University of Arkansas for Medical Sciences, two pediatricians from the Department of Pediatrics, a representative from the State Department of Education, and a developmental psychologist employed by the Department of Pediatrics. Topics (critical issues) our committees wanted more information about follow:

1) History of the concept of ADD, and its relation to Attention deficit Hyperactivity Disorder (ADHD) and to the earlier Minimal Brain Dysfunction (MBD) construct. Some of what has been written about the history of these constructs is inaccurate and misses important papers.

2) Different definitions of ADD/ADHD, which includes all those in the present psychiatric diagnostic manuals (DSM-III and DSM-III-R) including a best estimate of the DSM-IV definition. This should also include various research diagnostic criteria that have been proposed by different writers and organizations.

3) Epidemiology of ADD/ADHD and how this varies as a function of types of surveys, definitions of ADD/ADHD, and groups studied.

4) Etiology (probable causes), which considers both environmental and genetic causes as well as their interaction.

5) Conditions comorbid with ADD/ADHD such as oppositional-defiant, conduct, anxiety, and mood disorders. How does one identify these other conditions? Is ADD/ADHD really a separate disorder?

6) Biological associates of ADD/ADHD such as biochemical and neurological findings. Some parents want something more objective than ratings of behavior as a diagnosis for ADD/ADHD and as a basis for placing their children on medication.

7) Experimental psychological approaches to the study of ADD/ADHD. Do studies support the notion that the basic problems of these children are hyperactivity, inattention, and impulsivity? One of the teachers we interviewed thought that the term ADD/ADHD is a detriment to remediation; i.e., the design of programs tailored to the diverse needs of children. Forgetting labels, is a given child hyperactive

and/or inattentive? What is the impact of symptoms on classroom performance? And what can be done other than to place the child on medication?

8) Rating scale literature with special attention to scales that reliably assess ADD/ADHD.

9) Structured interviews that can be administered by lay persons and/or professionals, including their value in diagnosis. (This relates to 5 above.)

10) Objective tests that are useful in delineating the characteristics of ADD/ADHD children, in recommending remedial work, and in finding out whether these children also have a specific learning disability.

11) Formal assessment including the assessment of aggression and hypoactivity (the latter a part of the original MBD concept). It was recognized in the MBD era that some hypoactive or normally active children were also impulsive and inattentive.

To help expand and address this list of critical issues, we began surveying the literature and acquiring references. Abstracts of ADD/ADHD research articles published in the last 10 years were entered into our Empress Database System. We have also incorporated into this data base system older, important articles that were in our existent files before this research began. A considerable amount of time has been spent in acquiring the original articles upon which the abstracts are based, and we have only about three-fourths of them at the present time. Our basic data file consists of some 1400 references. Abstracts or articles are filed such that we can easily access any combination using key words appearing in any set of them: e.g., all articles in which the phrase rating scale appears. Much fine tuning remains to be done. Suppose we wish to locate all articles that have to do with ADD/ADHD as a risk factor for Conduct Disorder. We start by pulling up all articles with the words Conduct Disorder and risk. We know that some abstracts or articles that contain pertinent information will not use the word risk. So we have to read all abstracts that contain the words Conduct Disorder and add the word risk to these. The coding gets complicated with phrases such as Conduct Disorder - Risk - Same or Conduct Disorder - Risk -Separate; the first refers to papers that consider ADD/ADHD and Conduct Disorder to be a single disorder and the second to papers that treat Conduct Disorder and ADD/ADHD as separate disorders. It should be evident that obtaining hard copies of all abstracts and coding these properly is an immense job, and one that will difficult to do with impeccable accuracy within the time constraints set up by the grant. Suffice it to state our work on this project will continue after the current education grant terminates.

2.0 History.

A great number of writers have speculated about brain behavior relationships (Kluver, 1951; Pavlov, 1927; Sherrington, 1906, 1953). Ross and Ross (1976) trace the concept of hyperactivity back to neurological papers by Still (1902) and Tredgold (1908). Still described children who exhibited violent outbursts, wanton mischievousness, destructiveness, a lack of responsiveness to punishment, and an abnormal incapacity for sustained attention. While these are characteristics of some hyperactive children, they are mainly applicable to children now diagnosed with conduct disorder.

Ross and Ross (1976) attribute the first clear statement of the concept of minimal brain damage to Tredgold (1908). Many of the children Tredgold describes are similar to children now diagnosed as hyperkinetic. However, these were mentally retarded children who had in addition to hyperkinesis such

signs or symptoms as follows: large head size or shape, various soft neurological signs, poorly developed coordination, and inattentiveness. Tredgold assumed that these symptoms were the result of an inherited brain defect and thought that environment was of little or no consequence in etiology.

It is important to note that Still and Tredgold wrote about minimal brain damage, which is related to minimal brain dysfunction (MBD) but is not the same construct. MBD has more to do with subtle differences in the "wiring" of neuronal connections (i.e., neurotransmitter deficiencies in today's language) than with structural damage to the brain.

The MBD label became popular with the publication of a paper by Clements and Peters (1962) and even more so via a book written by Paul Wender (1971). Clements and Peters were greatly influenced by the pioneering work of Strauss and Lehtinen (1947), who enumerated the characteristics of children with known brain damage; the study of Bradley (1937) showing that Benzedrine reduced hyperactivity; the studies of Pasamanick et al. (1956) and Kawi and Pasamanick (1958), who emphasized the role of perinatal risk factors (e.g., bleeding in pregnancy, low birth weight) in causing behavior and learning problems; and a variety of other papers suggesting that neurological impairment results in behavioral and emotional symptomatology (Bender, 1952; Burks, 1960: Eisenberg, 1957; Gerstmann, 1940; Hallgren, 1950; Laufer et al., 1957; and Lawrence, 1960). The MBD term as used by Clements and Peters designated children who were hyperactive, learning disabled (LD) or both hyperactive and LD. It included one or more of the following signs: specific learning deficits, perceptual motor deficits, general coordination deficits, hyperkinesis (extreme overactivity), impulsivity, emotional lability, short attention span and/or distractibility, "equivocal" neurological signs, and borderline abnormal or abnormal EEG. Clements and Peters gave a description of MBD that could be used to describe ADD/ADHD today:

> "It is important to emphasize that a given child may not have symptoms in all or even many of these areas; each child has his own particular cluster of symptoms. The level of his intelligence and the nature of his underlying temperament determine the form and the excellence of his maneuvers to compensate for the deficits or deviations.
>
> It is probable that certain general principles underlie the above symptoms. For example, most may be due to perceptual defects having to do with the capacity to receive, hold, scan, and selectively screen out stimuli in a sequential order; to sustain a repertoire of background gestalten as compared to foreground gestalten; to perceive the subtle and often abstract behavior gestalten which allow proper socialization to take place. Proprioception may be one of the perceptual areas at fault in some of these children, i.e., manifesting as a deficiency in the ability to perceive, discriminate between, and retain images of sequential body movements in space. It may be that there is a deficiency in inhibitory functions having to do with checking and suspending verbal or motor activity until the incoming sensory stimuli are compared with stored information. When the fantastic complexity of the brain is considered, with its myriad interlocking circuits and groupings of circuits, it is not surprising that in the presence of any disordering of stimuli-monitoring that each child should manifest a unique cluster of symptoms, and that he should be handicapped in learning and adaptive behavior if the environment is sufficiently trying relative to the magnitude of the defect" (pages 188-9).

It is clear, as suggested above, that Clements and Peters were writing about issues which later became translated into ADD or ADHD:, namely problems of attention, impulsivity, hyperactivity, and working memory (incoming stimuli compared with stored information).

The MBD label excluded children with other serious psychiatric problems--autism, schizophrenia, and mental retardation. It was argued that for a child to receive the MBD label, he/she must be near average, average, or above average in intelligence. It was generally felt that the IQ cutoff should be 85 to 90.

Because learning and behavior are regulated by the brain, it was believed by Clements and Peters that it was best to think of these children as having some kind of brain dysfunction, but not necessarily damage as manifested by a neurological examination. The argument was really quite simple; namely that the core problems of these children--their excessive activity, inattentiveness, impulsivity, distractibility, and their oft occurring but relatively specific neurological signs (Peters et al., 1974, 1975)--had to be due in most cases to something wrong with the central nervous system.

In commenting on the MBD concept some 30 years later, Barkley (1990) states that:

> "The concept of MBD died a slow death as it became recognized as vague, overinclusive, with little or no prescriptive value, and without much neurological evidence (Kirk, 1963). Its value remained in its emphasis on neurological mechanisms over the often excessive, pedantic, and convoluted environmental ones proposed at that time. This was particularly true of those etiological hypotheses stemming from psychoanalytic theory, which blamed parental and family factors entirely for these problems" (p.10).

Taylor (1986) describes MBD as an unsavory neurological construct. He cites Bax and McKeith (1963) who say that the vagaries of MBD are not only a barrier to communication but can do harm by making physicians think they have done something useful in applying the label MBD. Of course, at least one useful thing has been done by freeing parents from the guilt of mismanagement. Yet, Taylor states that it may be useful for clinicians to use the term MBD in advising parents or teachers, when the intent is to explain that an individual child's problems might be caused by cerebral pathology. So while Taylor does not want the term as a diagnostic label, he is apparently not opposed to its use in communicating the causes of a child's problems to parents. Taylor is wrong, however, when he says that MBD implies a single cause for many forms of learning disability. As may be seen by the quote from Clements and Peters above, MBD refers to a variety of different cerebral dysfunctions, but one can only guess which ones from knowing the symptoms of a given child.

Although we (Dykman et al., 1971) played a role in the demise of the MBD concept by suggesting the substitute term Attentional Deficit Syndrome, we have never understood the harsh criticisms MBD received. A neurological colleague once said MBD is a term developed by persons who themselves have minimal brains. But there are many good and logical reasons to believe that LD and ADD involve deficits of the central nervous system, and more specifically some lack of inhibitory controls for ADD with hyperactivity (Dykman et al., 1971). First, many so-called MBD children were predisposed by congenital factors and/or environmental vicissitudes affecting the central nervous system (virus infections, birth trauma, developmental effects in utero) to manifest the described behaviors--inattention, impulsivity, and excessive activity/restlessness, and/or learning disabilities. Second, there was adequate familial data then, and both familial and twin data now, to suggest that heredity, is a predisposing factor (see etiology section). Third, the label MBD, as does ADD/ADHD now, relieved

many parents of tremendous self-blame–thinking of themselves as inadequate, particularly when asked by school teachers and principals the reasons for their children not behaving or performing adequately in school. Moreover, most children receiving the MBD label from white middle class families who had given their children the same emotional and cultural experiences that normally behaving school children had received from their families. The children now classified as ADD/ADHD tend to be more heterogenous as regards sex, race, and social class than the children given the MBD label earlier in history. The operant zeitgeist that pervaded both psychology and psychiatry during the "MBD era" attributed everything to environment, and the notion that behavior other than mental retardation might have biological causes was unacceptable to most psychologists.

Is the MBD concept dead? At least for learning disabilities (LDs) it is alive in some circles. The National Joint Committee on Learning Disabilities (NJCLD, 1989) defined LDs in terms of MBD. This definition has gained wide acceptance according to Bigler, 1992; it states that LDs are "intrinsic to the individual, presumed to be due to CNS [central nervous system] dysfunction, and may occur across the life span" (p. 1, NJCLD document). This assumes that learning disabilities have neurological causes and may be permanent. It is well known that learning disabilities may persist into adult life and may attenuate or worsen with aging (Gerber et al., 1990). Bigler (1992) reviews the now extensive neurobiological and neurophysiological literature supporting the NJCLD definition. The evidence is overwhelmingly in favor of a neurologically based disorder.

It is perhaps important to note that a number of pediatricians still use the MBD conceptualization in describing children. One of our physicians at Arkansas Children's Hospital, Dr. Mark Swanson (personal communication) outlines 8 ways in which learning disabilities and attention deficit disorders are similar:

1. Both have a presumed, if not precisely identified, underlying abnormal anatomic or physiologic brain process.

2. Both are disorders on a continuum, from mild to severe, leading to a certain arbitrariness about who "has" the condition.

3. Both have been functionally, or operationally, defined as a series of clinical behaviors.

4. Both are clinically diagnosed, with no unequivocal physiologic tests available to the physician to aid in diagnosis.

5. Both are likely present but unexpressed at birth (i.e., often children with these conditions are not identified until school age and only retrospectively are some subtle indicators apparent in the preschool years).

6. Both have clinical manifestations that vary greatly with environmental factors, especially those at home and in school.

7. Both require input and assessment from non-medical professionals.

8. Both have interventions that are largely derived from collective wisdom and experience, rather than from unequivocal scientific studies.

We (Dykman et al. 1971) became concerned with the issue of what MBD children have in common, and attempted to resolve this by hypothesizing an Attentional Deficit Syndrome. We said:

> "This chapter presents evidence pertaining to the hypothesis that there is a specific learning disability syndrome with the cardinal symptom of defective attention. Attention is treated as a unitary trait consisting of four interrelated components: alertness, stimulus selection, focusing, and vigilance. It may be, however, that future research will show these components to be independent" (p.57).

Many persons who read this article thought that it applied only to LD children because that happened to be the focus of the book. But a careful reading of the article indicates that we were asking the question of what all MBD children have in common, and, as pointed out above, MBD at the time referred to both hyperactive and LD children. We were thinking of both LD and hyperactivity as related but separate developmental disorders, since either could occur without the other (Dykman et al., 1976, 1985).

By 1976 we felt that the attentional approach was not a sufficient causal explanation (Dykman & Ackerman, 1976a, 1976b), and proposed an information processing model of MBD. At this time, we became concerned with the role of intention. Then in 1976, we wrote as follows:

> "Occam's Razor says that we should move from the simple to the complex in experimentation and interpretation. We should not look for a higher level of explanation when a lower level explanation suffices. From this standpoint the most parsimonious approach is to consider arousal as the basic defect for MBD [could be said for ADD today]. We have been down this road before, and for various reasons, which will become clear as we go along, it has not proved satisfactory. In 1971...we turned to attention as the next elementary phenomenon. Still dissatisfied, we now move to a considerable elaboration, adding intention and other psychological processes (Douglas, 1972). There are significant differences between the concepts of attention and intention, at least as we define them. Attention relates to the adequacy of one's informational gathering ability, focusing and stimulus selection (sampling environment). Intention has more do with the utilization of information, its implications and consequences (Shannon and Weaver, 1962). In a broader philosophical sense, intention connotes attitudes, values, will power, or sustained attention (James 1890). The philosophical and neurophysiological question is the same: Is it that the MBD child cannot sustain his attention or will not?
>
> ..."Two kinds of behavioral/deficiencies produced by injuries of the frontolimbic areas and associated cortex (Milner, 1963) are very similar to those seen in MBD children--hyperactivity, impulsiveness, perseveration or inability to switch from one action to another, dissociation of action and verbalization, and disregard for rules and consequences. Clearly these behaviors tend to be associated more with intention than attention, if there is a difference. Perhaps, we are talking about two aspects of faulty attention--one a defect in the primary sensory pathways having to do with the reception and storage of information and the other with inattentiveness (intention) as a personality trait." (p. 40, 1976a)

Virginia Douglas did much to change the MBD concept to ADD with her presidential address to the Canadian Psychological Association in 1972. The subsequent paper entitled "Stop, Look, and Listen" caught the fancy of American psychologists. She presented evidence suggesting that the problems of inattention and impulsivity were more important defining characteristics than hyperactivity (see also Campbell et al., 1971). The research of Douglas and collaborators indicated that sustained attention was a major problem for hyperactive children and that these children's problems of sustaining attention could occur in situations where there were no significant distractions (Freibergs and Douglas, 1969; Parry, 1973).

Douglas (1980a, 1980b, 1983) emphasized four major deficits for ADD children: 1) inability to inhibit impulsive responses; 2) inability to modulate arousal levels; 3) an inordinate need to seek immediate reinforcement; and most important 4) deficits in the regulation of attention and effort (our intention notion).

Colleagues of Douglas at McGill University have contributed much to our understanding of ADD/ADHD/MBD. Particularly important was the research of Gabrielle Weiss and associates, who followed the development of hyperactive children into adolescence and adulthood (Hechtman et al., 1984b; Weiss & Hechtman, 1986). Weiss noted that while the excessive motor activity of these children often diminished by adolescence, their problems with sustained attention and impulsivity persisted. There are many additional studies indicating that hyperactivity may result in appreciable problems in later life (Ackerman et al., 1977; Mendelson et al., 1971; Gittleman et al., 1985; Barkley et al., 1990; Satterfield et al., 1988).

Another significant contributor in the MBD period was Keith Conners, who developed the first rating forms to assess hyperactivity, impulsivity, and inattention (Conners, 1969). Conners was among the first to recognize inattention and impulsivity as major problems of these children. Conners' impact on the field of disruptive behavior disorders continues to this day. Conners has done more to stimulate the development of rating scales assessing child psychopathology than any other person.

ADD was separated from LD in the Diagnostic and Statistical Manual of the American Psychiatric Association (DSM-III) and in the subsequent revision of this manual DSM-III-R. DSM-III described two subtypes of ADD children, those with and those without hyperactivity. For reasons questionable to some (see Cantwell & Baker, 1989), these two subtypes were lumped into one category in DSM-III-R referred to as Attention Deficit Hyperactivity Disorder (ADHD). (We believe it necessary to repeat some abbreviations for clarity.)

The degree of overlap of LD and ADHD is appreciable (Dykman et al., 1985, 1991; Hynd, 1990; Shaywitz & Shaywitz, 1989). A substantial proportion of LD children are also ADD, and in laboratory tests of attention it is difficult to discriminate ADD children not LD and LD children not ADD (Dykman et al., 1985). **There is certainly no logical basis to classify ADD as a mental disorder and LD as a developmental disorder as was done in DSM-III but rectified in DSM-III-R.** In the R-version, ADHD is classified as a developmental disorder under the general category of disruptive behavior disorders. This category also includes the oft closely related Oppositional Defiant Disorder and Conduct Disorder. It is stated that in both clinic and community samples, the symptoms of these three disorders covary to a high degree. The symptoms of these three behavior disorders are referred to as externalizing symptoms in the literature.

About 1980, Barkley and others began to question the concept of attention deficit as the defining characteristic for ADD/ADHD (Barkley, 1981, 1984; Sergeant, 1988). It was recognized that children

in many psychiatric diagnostic categories were overactive and inattentive. And it was noted that the excessive activity of the children who were labeled ADD tended to be situational in nature and did not occur in all conditions (Rutter, 1989).

Also, during this period, there was a tremendous outcrying against the number of these children who were placed on drugs--stimulant medication in particular. It was claimed that the medications prescribed for these children would stunt their growth, and respectable investigators were accused of being paid off by the drug companies. It was stated that hyperactivity results from such factors as poor nutrition (see review by Milich et al., 1986), rapid cultural changes (Block, 1977), or food allergies (Feingold, 1975), or that hyperactivity is a "myth" created by poor teachers and parents (Conrad, 1975; Schrag & Divoky, 1975). But none of these claims could be backed up by any reasonable scientific evidence (Barkley, 1990; Conners, 1980, Ross & Ross, 1982).

In his generally excellent book, Barkley (1990) states that one of the most exciting developments of the eighties was the notion that ADD is a motivational disorder and not an attention disorder, which goes back to the inclusion of intention in the MBD era. In fairness, however, it is important to state that the motivational emphasis that emerged in the eighties was based upon research and not clinical observation/intuition. In discussing this "newer" movement, Barkley writes:

> "As more rigorous and technical studies of attention in ADHD children appeared in the 1980's, an increasing number failed to find evidence of problems with sustained attention **under some experimental conditions [emphasis ours]** while observing them under others (see Douglas, 1983, 1988 for reviews; Barkley, 1984, Sergeant, 1988; Sergeant & van der Meere, 1989; van der Meere & Sergeant 1988a, 1988b). These findings, coupled with the realization that both instructional and motivational factors played a strong role in determining the presence of ADHD symptoms, led some investigators to hypothesize that motivation may be a better model for explaining the deficits seen in ADHD children (Rosenthal & Allen, 1978; Sroufe, 1975). Following this line or reasoning, others pursued a functional analysis of these symptoms; they hypothesized deficits in the stimulus control over behavior, particularly by rules and instructions (Barkley 1981; Willis & Lovaas, 1977)" (pp. 26-27).

Barkley later added to a rule based deficit the notion that responses to behavioral consequence might also be impaired (Barkley, 1984, 1990). This same idea or notion was advocated by other writers (Beninger, 1989; Quay, 1988; Sergeant, 1988). The basic notion is that ADHD arises out of an insensitivity to consequences; i.e, reinforcement or punishment. This same idea had also been put forth earlier by Wender (1971) in his classic book on MBD and in our papers on intention. Lou et al. (1984, 1989) suggest that ADHD children exhibit deficits in brain-reward centers and their cortical regulating limbic circuits. In several papers, we described these same circuits as accounting for the difficulty of MBD children (Dykman & Ackerman, 1976a; Dykman et al., 1970; 1971).

2.1 Summary/Critique.

Even though the MBD label has been discarded, the reasoning which led to it is still used by many clinicians to explain the problems of ADD/ADHD children to parents. It is also apparent from the review of the literature that many of the critical issues which confront us today were present in the MBD era. It is possible that MBD or some equivalent term could come back into vogue as more evidence cumulates concerning the biological basis of ADD/ADHD.

3.0 Definitions.

We list here, in order, the basic criteria for the diagnosis of ADD as given in DSM-III, DSM-III-R, and our most recent information concerning DSM-IV. It will be noticed that both incorporate the same defining characteristics that were originally used for MBD; i.e., characteristics in the area of inattention, impulsivity, and hyperactivity. These appear to be highly correlated characteristics in most studies (see rating scales below), and this lends some validity to the unitary conception of ADHD in DSM-III-R. But the fact that traits tend to covary together does not preclude them from being independent to some degree. This section also lists definitions utilized in research studies and definitions pertaining to subtypes. It is important to note at the outset that many primary physicians use the International Classification of Diseases, 9th revision, published by the World Health Organization to diagnose Hyperkinesis, a more severe form of ADHD. DSM definitions of ADD/ADHD are more often used by physicians in the U.S.

3.1 DSM-III Criteria for Attention-Deficit Disorder with Hyperactivity (Copied Directly from DSM-III Manual).

The child displays, for his or her mental and chronological age, signs of developmentally inappropriate inattention, impulsivity, and hyperactivity. The signs must be reported by adults in the child's environment, such as parents and teachers. Because the symptoms are typically variable, they may not be observed directly by the clinician. When the reports of teachers and parents conflict, primary consideration should be given to teacher reports because of greater familiarity with age-appropriate norms. Symptoms typically worsen in situations that require self-application, as in the classroom. Signs of disorder may be absent when the child is in a new or a one-to-one situation.

The number of symptoms specified is for children between the ages of eight and ten, the peak age for referral. In younger children, more severe forms of the symptoms and a greater number of symptoms are usually present. The opposite is true for older children.

A. **Inattention.** At least 3 of the following:

(1) often fails to finish things he or she starts
(2) often doesn't listen
(3) easily distracted
(4) has difficulty concentrating on schoolwork or other tasks requiring sustained attention
(5) had difficulty sticking to a play activity

B. **Impulsivity.** At least three of the following:

(1) often acts before thinking
(2) shifts excessively from one activity to another
(3) has difficulty organizing work (this not being due to cognitive impairment)
(4) needs a lot of supervision
(5) frequently cails out in class
(6) has difficulty awaiting turn in games or group situations

C. **Hyperactivity.** At least two of the following:

(1) runs about or climbs on things excessively
(2) has difficulty sitting still or fidgets excessively
(3) has difficulty staying seated
(4) moves about excessively during sleep
(5) is always "on the go" or acts as if "driven by a motor"

D. Onset before the age of seven.

E. Duration of at least six months.

F. Not due to Schizophrenia, Affective Disorder, or Severe or Profound Mental Retardation.

3.2 DSM-III Criteria for Attention Deficit Disorder without Hyperactivity (Copied Directly from the Manual).

The criteria are the same as those for attention deficit disorder with hyperactivity except that the individual never had signs of hyperactivity (criterion C).

3.3 DSM-III Diagnostic Criteria for Attention Deficit Disorder, Residual Type (Copied Directly from the Manual).

A. The individual once met the criteria for attention-deficit disorder with hyperactivity. This information may come from the individual or others, such as family members.

B. Signs of hyperactivity are no longer present, but other signs of the illness have persisted to the present without periods of remission, as evidenced by signs of both attention deficits and impulsivity, e.g. difficulty organizing work and completing tasks, difficulty concentrating, being easily distracted, making sudden decisions without thought of the consequences.

C. The symptoms of inattention and impulsivity result in some impairment in social or occupational functioning.

D. Not due to schizophrenia, affective disorder, severe or profound mental retardation, or schizotypal or borderline personality disorders.

3.4 Explanatory Comment.

The DSM-III requires that ADD be considered separately from disturbances of conduct with which it was often confused in DSM-II. In DSM-III, the clinician is instructed to first find out if the child can be diagnosed as ADD, second find out if the child is hyperactive, and third find out if there is a pattern of disruptive behaviors that violate the rights of others.

When DSM-III-R was developed the diagnosis ADD without hyperactivity was placed in a relatively vague category called Undifferentiated ADD on the grounds that there was insufficient evidence to warrant its inclusion. It was suggested that more research be done on the utility of the ADD without diagnosis. Barkley (1990) states that this was a prudent gesture on the part of the committee inasmuch

as there was little available research to guide the committee responsible for the definition of ADD. Carlson (1986) later characterized ADD without hyperactivity children as daydreamy, hypoactive, lethargic, and learning-disabled in academic achievement. According to Barkley, this research came too late to have an impact on the DSM-III-R definition. We would only add that there was literature to support the inclusion of the ADD without category going back to the early MBD days (see History Section above).

3.5 DSM-III-R General Criteria (Copied Directly from the Manual).

The essential features of this disorder are developmentally inappropriate degrees of inattention, impulsiveness, and hyperactivity. People with the disorder generally display some disturbance in each of these areas, but to varying degrees.

Manifestations of the disorder usually appear in most situations, including at home, in school, at work, and in social situations, but to varying degrees. Some people, however, show signs of the disorder in only one setting, such as at home or at school. Symptoms typically worsen in situations requiring sustained attention, such as listening to a teacher in a classroom, attending meetings, or doing class assignments or chores at home. Signs of the disorder may be minimal or absent when the person is receiving frequent reinforcement or very strict control, or in a novel setting or a one-to-one situation (e.g., being examined in the clinician's office, or interacting with a video game).

In the classroom or workplace, inattention and impulsiveness are evidenced by not sticking with tasks sufficiently to finish them and by having difficulty organizing and completing work correctly. The person often gives the impression that he or she is not listening or has not heard what has been said. Work is often messy, and performed carelessly and impulsively.

Impulsiveness is often demonstrated by blurting out answers to questions before they are completed, making comments out of turn, failing to await one's turn in group tasks, failing to heed directions fully before beginning to respond to assignments, interrupting the teacher during a lesson, and interrupting or talking to other children during quiet work periods.

Hyperactivity may be evidenced by difficulty remaining seated, excessive jumping about, running in classroom, fidgeting, manipulating objects, and twisting and wiggling in one's seat.

At home, inattention may be displayed in failure to follow through on others' requests and instructions and in frequent shifts from one uncompleted activity to another. Problems with impulsiveness are often expressed by interrupting or intruding on other family members and by accident-prone behavior, such as grabbing a hot pan from the stove or carelessly knocking over a pitcher. Hyperactivity may be evidenced by an inability to remain seated when expected to do so (situations in which this is the case vary greatly from home to home) and by excessively noisy activities.

With peers, inattention is evident in failure to follow the rules of structured games or to listen to other children. Impulsiveness is frequently demonstrated by failing to await one's turn in games, interrupting, grabbing objects (not with malevolent intent), and engaging in potentially dangerous activities without considering the possible consequences, e.g., riding a skateboard over extremely rough terrain. Hyperactivity may be shown by excessive talking and by an inability to play quietly and to regulate one's activity to conform to the demands of the game (e.g., in playing "Simon Says," the child keeps moving about and talking to peers when he or she is expected to be quiet).

Age-specific features. In preschool children, the most prominent features are generally signs of gross motor overactivity, such as excessive running or climbing. The child is often described as being on the go and "always having his motor running." Inattention and impulsiveness are likely to be shown by frequent shifting from one activity to another. In older children and adolescents, the most prominent features tend to be excessive fidgeting and restlessness rather than gross motor overactivity. Inattention and impulsiveness may contribute to failure to complete assigned tasks or instruction, or careless performance of assigned work. In adolescents, impulsiveness is often displayed in social activities, such as initiating a diverting activity on the spur of the moment instead of attending to a previous commitment (e.g., joy riding instead of doing homework).

Associated features. Associated features vary as a function of age, and include low self-esteem, mood lability, low frustration tolerance, and temper outbursts. Academic underachievement is characteristic of most children with this disorder.

In clinic samples, some or all of the symptoms of Oppositional Defiant Disorder, Conduct Disorder, and Specific Developmental Disorders are often present. Functional Encopresis and Functional Enuresis are sometimes seen. Although Tourette's Disorder is relatively rare in children with ADHD, in clinic samples many children with Tourette's Disorder are found to have ADHD as well.

Nonlocalized, "soft," neurologic signs and motor-perceptual dysfunctions (e.g., poor eye-hand coordination) may be present.

Age at onset. In approximately half of the cases, onset of the disorder is before age four. Frequently the disorder is not recognized until the child enters school.

Course. In the majority of cases, manifestations of the disorder persist throughout childhood. Oppositional Defiant Disorder or Conduct Disorder often develops later in childhood in those with ADHD. Among those who develop Conduct Disorder, a significant number are found to have Antisocial Personality Disorder in adulthood. Follow-up studies of clinic samples indicate that approximately one-third of children with ADHD continue to show some signs of the disorder in adulthood. Studies have indicated that the following features predict a poor course: coexisting Conduct Disorder, low IQ, and severe mental disorder in the parents.

Impairment. Some impairment in social and school functioning is common.

Complications. School failure is the major complication.

Predisposing factors. Central nervous system abnormalities, such as the presence of neurotoxins, cerebral palsy, epilepsy, and other neurologic disorders, are thought to be predisposing factors. Disorganized or chaotic environments and child abuse or neglect may be predisposing factors in some cases.

[We believe it is a mistake to classify children with the neurological disorders or environmental handicaps described in the foregoing paragraph as ADHD. These children should be given some other label(s). The inclusion of these other conditions makes the group to which the label is applied far too diverse or heterogenous.]

Prevalence. The disorder is common; it may occur in as many as 3% of children.

Sex ratio. In clinic samples, the disorder is from six to nine times more common in males than in females. In community samples, multiple signs of the disorder occur only three times more often in males than in females.

Familial pattern. The disorder is believed to be more common in first-degree biologic relatives of people with the disorder than in the general population. Among family members, the following disorders are thought to be over-represented: Specific Developmental Disorders, Alcohol Dependence or Abuse, Conduct Disorder, and Antisocial Personality Disorder.

Differential diagnosis. Age-appropriate overactivity, as is seen in some particularly active children, does not have the haphazard and poorly organized quality characteristic of the behavior of children with Attention-Deficit Hyperactivity Disorder. Children in **inadequate, disorganized,** or **chaotic environments** may appear to have difficulty in sustaining attention and in goal-directed behavior. In such cases it may be impossible to determine whether the disorganized behavior is primarily a function of the chaotic environment or whether it is due largely to the child's psychopathology (in which case the diagnosis of Attention-Deficit Hyperactivity Disorder may be warranted).

In **Mental Retardation** there may be many of the features of ADHD because of the generalized delay in intellectual development. The additional diagnosis of ADHD is made only if the relevant symptoms are excessive for the child's mental age.

Symptoms characteristic of ADHD are often observed in **Pervasive Developmental Disorders;** in these cases a diagnosis of ADHD is preempted.

In **Mood Disorders** there may be psychomotor agitation and difficulty in concentration that are difficult to distinguish from the hyperactivity and attentional difficulties seen in Attention-deficit Hyperactivity Disorder. Therefore, it is important to consider the diagnosis of a Mood Disorder before making the diagnosis of Attention-deficit Hyperactivity Disorder.

Signs of impulsiveness and hyperactivity are not present in **Undifferentiated Attention-deficit Disorder.**

3.6 DSM-III-R Diagnostic Criteria for Attention-Deficit Hyperactivity Disorder (Copied Directly from the Manual):

Note: Consider a criterion met only if the behavior is considerably more frequent than that of most people of the same mental age.

A. A disturbance of at least six months during which at least eight of the following are present:

(1) often fidgets with hands or feet or squirms in seat (in adolescents, may be limited to subjective feelings of restlessness)

(2) has difficulty remaining seated when required to do so

(3) is easily distracted by extraneous stimuli

(4) has difficulty awaiting turn in games or group situations

(5) often blurts out answers to questions before they have been completed

(6) has difficulty following through on instructions from others (not due to oppositional behavior or failure of comprehension), e.g., fails to finish chores

(7) has difficulty sustaining attention in tasks or play activities

(8) often shifts from one uncompleted activity to another

(9) has difficulty playing quietly

(10) often talks excessively

(11) often interrupts or intrudes on others, e.g., butts into other children's games

(12) often does not seem to listen to what is being said to him or her

(13) often loses things necessary for tasks or activities at school or at home (e.g., toys, pencils, books, assignments)

(14) often engages in physically dangerous activities without considering possible consequences (not for the purpose of thrill-seeking), e.g., runs into street without looking

Note: The above items are listed in descending order of discriminating power based on data from a national field trial of the DSM-III-R criteria for Disruptive Behavior Disorders.

B. Onset before the age of seven.

C. Does not meet the criteria for a Pervasive Developmental Disorder.

3.7 DSM-III-R Criteria for Severity of Attention-Deficit Hyperactivity Disorder (Copied Directly from Manual):

Mild: Few, if any, symptoms in excess of those required to make the diagnosis and only minimal or no impairment in school and social functioning.

Moderate: Symptoms or functional impairment intermediate between "mild" and "severe."

Severe: Many symptoms in excess of those required to make the diagnosis and significant and pervasive impairment in functioning at home and school and with peers.

3.8 DSM-III-R Undifferentiated Attention-Deficit Disorder (Copied Directly from the Manual).

This is a residual category for disturbances in which the predominant feature is the persistence of developmentally inappropriate and marked inattention that is not a symptom of another disorder, such as Mental Retardation or Attention-Deficit Hyperactivity Disorder, or of a disorganized and chaotic environment. Some of the disturbances that in DSM-III would have been categorized as Attention Deficit

Disorder without Hyperactivity would be included in this category. Research is necessary to determine if this is a valid diagnostic category and, if so, how it should be defined.

3.9 DSM-IV (As it Stands at this Time).

This section summarizes a telephone conversation on 1/7/93 with Dr. Benjamin B. Lahey a member of the DSM-IV Child Disorders Work Group. The field trials for ADD/ADHD were conducted on a national sample of 440 children (ages 4-17) referred to clinics from all regions of the U.S. The clinics included those usually found in child study centers but also included those serving psychiatric inpatients and delinquents. Somewhere between 10 and 80 children were studied at each site with follow-up assessments every 12 months for four years. Three forms of the Diagnostic Interview Schedule for Children (DISC, see Section 3.0) were used: the DIS-C was administered to all children 9 years of age or older; the DIS-Teacher form was administered to teachers of children 8 years of age or younger; and the DIS-Parent form was administered to all parents of children in the sample. ADD/ADHD items on these various forms were supplemented by items suggested by members of the task force: the aim was to include any item that might be useful in identifying and subtyping these children. The investigators also had IQ measures (WISC-R for most children). Mentally retarded children were not included; all but two had IQs above 70.

It was found that symptoms of ADD/ADHD (hyperactivity, impulsivity, and inattention) were not correlated with IQ. It was surprising to find that IQ did not correlate with inattention.

The investigators looked at global impairment as assessed by the Children's Global Assessment Scale" (C-GAS, Shaffer et al., 1985). The metric was the subject's most impaired level of general functioning for each 12 months of the study, i.e., the lowest level that describes his or her functioning (10 levels with scores ranging from 1 to 100). Impairment was also rated in two other ways: amounts and accuracy of work completed in school and parent ratings of the amount of homework completed. Finally, investigators tabulated the number of oppositional and conduct disorder symptoms. It was found that inattention was related only to the academic ratings whereas the number of hyperactive symptoms related to the other two categories--global impairment and the number of oppositional and conduct disorder symptoms.

The validation of the definitions of ADD/ADHD were assessed in two other ways. First, clinicians were asked to look over all the DISC ratings, then interview the child and decide whether the child had, in fact, the symptoms of ADD with or without hyperactivity (ADHD). These ratings were found to be associated with the final definition (Kappa=0.6, which is about as well as can be expected in this kind of situation). Next, 100 cases were selected and the DISC measures were obtained again 10 days later. The test-retest reliability measures were adequate, in Dr. Lahey's words "pretty decent". From all this work, definitions of ADHD and ADD were created that, at last word (from Dr. Lahey), are still under debate by the committee. But the definitions as formulated at this point are supported by all measures of impairment described above. In fact, the three measures (global and academic impairment and symptoms of disruptive behavior) resulted in the same definitions and the same cut scores for separating ADD children with and without hyperactivity. This very excellent field trial research is in the process of being prepared for publication by Dr. Lahey.

It appears that impulsivity will not be a separate dimension of ADD as it was in DSM-III, and this is probably wise in that it has not been shown to be a separate factor; i.e., it loads with hyperactivity in factor studies. Among the unresolved issues at the time of writing are a) diagnostic criteria for adult

ADD; b) whether parent ratings or both parent and teacher ratings will be required (issue of pervasiveness); c) the separation of ADD and Oppositional-Defiant Disorders (there seems to be an obvious overlap of these disorders). There will be at least two major types of items in DSM-IV (judging by field trials): those having to do with inattention and those with impulsivity and hyperactivity.

While the final subtype definitions are not available at this time, there are likely to be two main categories: ADHD as a more global and more severely impaired group of children and youth with the classical symptoms of hyperactivity, impulsivity, and inattention, and ADD as a relatively pure disturbance of sustained and/or focussed attention. The field trial research also suggests a third subtype, children who are only hyperactive. But for the most part, these were preschool children, who had not as yet experienced the school environment; i.e., other classic symptoms may not as yet have emerged. Hyperactivity in the preschool years may be a risk factor for ADD or ADHD later on.

3.10 Barkley's Operational Definition.

Barkley (1982), presumably dissatisfied with the DSM-III criteria, formulated the following operational definition of ADD plus hyperactivity in order to select subjects for research projects. In addition to the usual parent and teacher ratings of inattention, impulsivity, and hyperactivity, Barkley stipulated that the symptoms had to:

> "1) be deviant for the child's mental age as measured by well standardized child behavior rating scales;
>
> 2) be relatively pervasive within the jurisdictions of the major caregivers in the child's life (parent/home and teacher/school);
>
> 3) have developed by 6 years of age; and
>
> 4) have lasted at least 12 months" (Barkley, 1982).

3.11 Research Criteria/Subtypes.

Loney and Milich, (1982) and Milich and Loney, (1980) added a new dimension to the description of ADD/ADHD by a careful statistical analysis of items on the Conners Rating Scale, namely, a factor of aggressiveness, an important predictor of long term outcomes. Children scoring high on the Loney and Milich items may or may not have the comorbid conditions of Oppositional or Conduct Disorder. Using criteria of convergent and divergent validity (Campbell and Fiske, 1959), Loney and Milich selected divergent sets of items to define two factors: Inattention/overactivity (I/O) and Aggression/defiance (A/D). While the two sets of items are statistically independent, this does not preclude cases in which both scores are low or high. This new scale, which includes items added by Loney and Milich to the Conners scale, is called the Iowa-Conners rating scale.

Swanson and Taylor (cited in Swanson, 1990) replicated the Loney and Milich study reporting that the dimensional pure I/O type represented about 25% of referred samples in California and London. In both locations, a type having high scores on both factors was in the majority (about 50%). The prevalence was low for two groups, 10% for the pure A/D group and 15% for the group low on both I/O and A/D.

Taylor et al. (cited by Swanson, 1990) suggest that I/O is a risk factor for A/D, which often emerges as a result of the ADD/ADHD child's interactions with his environment. Taylor et al. believe that the presence of A/D should not rule out a diagnosis of ADD/ADHD, and as a matter of fact, Dykman et al. (1990, 1991) have used the Iowa scale to define a subtype of ADD/ADHD that includes defiant and aggressive children who do not satisfy criteria for Conduct or Oppositional Disorders (see below).

Lahey et al., (1987) identified a 'hypoactive' [our word] inattentive type of ADD child. These children were described as sluggish, drowsy, daydreamy. More recently, Crinella et al. (1990) did a factor analysis of behavioral ratings of 25 subjects with confirmed brain damage, 35 with minimal brain damage symptoms, and 40 normal controls. The analysis produced two factors, aggression and inattention--ones that commonly show up in factor analyses of ADD/ADHD rating scales. The Crinella et al. inattention symptoms are similar to the 'hypoactive' items identified by Lahey et al. (1987). Crinella et al. referred to their inattention items as representing "hypoattentiveness." Voeller (1986;1991) and Voeller and Heilman (1988) have also studied this form of inattention and suggest that it may result from right hemisphere damage.

The concept of a hypoactive type has been around a long time. Luria (1961) described a child having a Cerbro-Asthenic Syndrome. He recognized two subtypes, one that resembles hyperactive LD children and the other hypoactive LD children (see Dykman et al., 1970). The first type was presumed to have inhibitory processes that are weak or deranged, with a consequent increase in distractibility and impulsiveness. In conditioned discrimination procedures they tend to respond impulsively to negative ("no go" or passive avoidance stimuli) and prematurely to positive ("go") stimuli. Luria stated that response latencies decrease over trials because the accumulating excitement disrupts inhibitory constraints. In the hypoactive subtype, inhibition is stronger than excitation, and, with a massing of conditioning trials, they may stop responding altogether. The hypoactive subtype is characterized by slow execution of purposeful movements (Dykman et al., 1970). According to Luria, the school performance of the two subtypes is similar in that both fail to keep pace with their classmates. In our words, both types of children have attention problems, one because of poor inhibitory controls and the other because of defects in motivation or effort, which could be brought about by continuous frustration at school. We used Luria's schema originally (Dykman et al., 1970) to classify learning disabled children into three subtypes: hyperactive, hypoactive, and normo-active (the latter category added by us). Clements and Peters (1962) from the very beginning recognized the hypoactive passive type of MBD child. It is also fair to say that clinicians in the sixties, and probably long before this time, recognized the two subtypes, the hypoactive subtype who dawdled but was not disruptive, and the excitable hyperactive subtype. Also, there are many hypoactive children that do not have a psychiatric disorder and are not LD (percentage unknown).

One of the most important relatively recent innovations is the development of strict Research Diagnostic Criteria (RDC). These were proposed by Sergeant (Bloomindale and Sergeant, 1988a, p.3) because DSM-III-R definitions resulted in an inordinately high prevalence rate.

The RDC criteria included suggestions made by Taylor (1986; 1988) and are in line with the criteria of the International Classification of Diseases (ICD), Version 9 (World Health Organization, 1978, Rutter et al., 1979) or Version 10 (World Health Organization, 1990). The specific recommendations follow:

> "1) A stringent severity criterion is recommended. The cutoff value (expressed in terms of symptoms required) is higher than the cutoff value specified in DSM-III or DSM-III-R;

the percentage required for a RDC diagnosis is 75% (6 out of 8), compared to 50% for DSM-III (8 our of 16) and 57% for DSM-III-R (8 out of 14).

2) Concurrent validation by standardized parent and teacher rating scales is required. The requirement of a 'statistically abnormal' score on a standardized rating scale should exclude all but a specified small percentage (e.g., 3% to 5%) of the children in the population defined by age and sex norms.

3) The temporal course of symptoms is specified. Early onset (before age 7 years) and duration (at least 2 years) are required to ensure that fluctuations in attention due to stress would not lead to a diagnosis.

4) The presence of symptoms in at least two of three settings (home, school, clinic) is required. Due to the low correlation between sources, this should reduce the prevalence of the disorder for any given level of severity."

Swanson et al. (1990) add further restrictions to the definition, increasing the homogeneity of children satisfying the above restrictive criteria. It is important to remember that this is for the stated purpose of obtaining a homogenous group of ADD/ADHD subjects. These are as follows:

"1) If the ADD/ADHD symptoms have an early onset and are expressed (perhaps in different but age expected forms) across developmental periods before another disorder is manifested, we recommend that the ADHD symptoms be considered primary.

2) If the symptoms of the other disorder appear first, or if the presence of ADD/ADHD symptoms varies with the waxing and waning of the other disorder or specified environmental conditions, we recommend that the ADD/ADHD symptoms be considered secondary.

3) We propose that a diagnosis of ADD/ADHD be made only on the basis of primary symptoms." (p. 387).

Swanson et al. are concerned with the overlap of ADHD and learning disabilities (LDs). California studies (Forness et al., 1991) indicate very little overlap when a 1.5 standard deviation discrepancy score between performance on standardized achievement and intelligence tests is used to define LD. Surprising, not a single one of their ADD/ADHD children qualified for LD when this discrepancy score was used. About 10% qualify for LD when a 1.0 standard deviation discrepancy score is used, and this agrees with results reported in the Connecticut longitudinal study (Shaywitz and Shaywitz, 1987) and the findings of a study in Holland (van der Meere, 1988). Swanson et al. believe that the overlap with other disorders including LD is minimal when the criteria outlined above are imposed. However, they recognize that these children may have various degrees of activity including passivity and aggressiveness. Using their more restricted definition, Swanson et al. were able to say that the term attention deficit is warranted (see Section 7 below for details). A limitation of the Swanson data is that it may not be representative of sex, age, race, and social class, factors that would markedly affect the LD and ADD/ADHD overlap (Pennington et al., in press). Also, the estimate of minimal overlap by Swanson is out of line with work being done elsewhere (see Section 4 below).

3.12 Other Investigations with Attention Deficit Disorder with Hyperactivity and Attention Deficit Disorder without Hyperactivity Subgroups.

Lahey and Carlson (1991) have recently reviewed the literature on ADD without hyperactivity as diagnosed by DSM-III criteria. Lahey and his associates have been at the forefront in arguing for the validity of the ADD without hyperactivity category and in criticizing the change to Undifferentiated Attention Deficit Disorder (UADD) in DSM-III-R (see also Lahey, et al., 1988).

Lahey and Carlson (1991) conclude that factor analytic studies consistently identify two largely independent dimensions among the symptoms of ADD, 1) motor hyperactivity and impulsive behavior and 2) inattention, disorganization, and difficulty in completing tasks. Moreover, when the score on these two factors are cluster analyzed, two subtypes are identified who essentially correspond to the two subtypes in DSM-III. Lahey and Carlson also present experimental evidence attesting to both convergent and divergent validity. Convergent validity is provided primarily from various ratings made by parents and teachers. The evidence is consistent whether from clinic referred or school based samples.

As noted earlier, the critical question is whether these two subtypes differ on other behaviors or characteristics or in terms of etiology, prognosis, or response to treatment. Studies using both school based and clinic-referred samples have consistently shown hyperactive ADD children to be rated more adversely on impulsivity and aggressive/defiant symptomatology than nonhyperactive ADD children, whereas nonhyperactive ADD children are rated more adversely on internalizing symptomatology such as anxiety, and withdrawal or shyness (Barkley, DuPaul, & McMurray, 1990; Berry, Shaywitz, & Shaywitz, 1985; Cantwell & Baker, 1992; Edelbrock, Costello, & Kessler, 1984; Lahey, Schaughency, Strauss, & Frame, 1984; Shaywitz, Schnell, Shaywitz, & Towle, 1986).

Both types of ADD children exhibit more difficulties in academic areas than controls, but neither group has been consistently found to have greater problems than the other (Carlson, Lahey, & Neeper, 1986; Lahey et al., 1984). Studies contrasting hyperactive and nonhyperactive ADD children on cognitive/neuropsychological measures have provided mixed results. Of those reviewed by Lahey and Carlson (1991), half found few or no differences. Sargeant and Scholten (1985a, 1985b) studied two small (N=8) groups of ADD children with hyperactivity and ADD children without hyperactivity in a visual search task where speed and accuracy were compared. Compared with controls, both groups were significantly slower but only the ADDH children were less accurate. Sargeant and Scholten (1985b) also concluded that hyperactive ADD children showed deficits in resource allocation, since they were less able than nonhyperactive ADD and control children to meet task demands. The hyperactive group's latencies were inconsistently related to accuracy, whereas the other groups exhibited the oft-reported speed-accuracy trade-off. Frank and Ben-Nun (1988) found hyperactive ADD children (N=21) to show significantly greater abnormalities than nonhyperactive ADD children (N=11) in visual perception, visual sequential memory, and writing performance. The hyperactive group also showed significantly greater abnormality on "soft" neurological signs.

Larger samples of hyperactive (N=42) and nonhyperactive (N=48) ADD children were recently contrasted by Barkley et al. (1990). In addition to comprehensive ratings obtained from parents and teachers, the investigators analyzed performance on the WISC-R and WRAT-R and on several laboratory tasks. They also made behavioral observations as the children performed on selected tasks. The hyperactive ADD but not the nonhyperactive ADD group had significantly poorer scores than controls on the arithmetic subtest of the WISC-R. The nonhyperactive group was significantly poorer on the coding subtest than both the hyperactive group and controls. The hyperactive and nonhyperactive ADD

groups did not differ, however, on any of the WRAT-R subtests nor in the percentage identified as having specific learning disabilities. On a Continuous Performance Task (CPT), the hyperactive ADD group had more errors of omission than the control group but the two ADD subgroups did not differ. Neither did they differ in errors of commission even though the mean of the hyperactive ADD group was double that of the nonhyperactive ADD group (scores were highly variable, however). During the CPT, the hyperactive ADD children were observed to be off-task significantly more than the nonhyperactive ADD children, but, during a math problems task, the two subgroups did not differ in ratings of off-task behavior. The nonhyperactive group but not the hyperactive group completed significantly fewer problems than controls. The two groups did not differ in errors or latencies on the Matching Familiar Figures Test, which is hypothesized to measure impulsivity (Kagan, 1964). Nor did the groups differ in activity level as measured by wrist and ankle actometers.

Thus, the Barkley et al., (1990) study did not uncover as many performance differences between the hyperactive and nonhyperactive ADD children as hypothesized, but the nonhyperactive children were less efficient in coding and solving math problems. As in other studies, parent and teacher ratings and family history measures provided stronger separation of groups.

Barkley, DuPaul, & McMurray (1991) studied approximately half the hyperactive and nonhyperactive ADD subjects of the above study in a blinded, placebo-controlled crossover design to assess clinical response to methylphenidate at the three dose levels. The groups were not found to differ significantly on any measures in their response to medication. However, more nonhyperactive ADD children were clinically judged to have either no clinical response (24%) or as responding best to the low dose (35%), whereas 95% of the hyperactive ADD children were judged to be positive responders and most (71%) were recommended to receive the high dose (15 mg twice a day).

3.13 Dykman et al. 3-subtype Theory.

This research was based on the work of Loney and Milich (1982). For a relatively large ADD sample (159 boys meeting DSM-III criteria for ADD with and without hyperactivity disorder), we did a K-means cluster analysis of the scores from the two Iowa factors and from our own ADD index (composed of 10 attention items from DSM-III). We closely adhered to the recommendations of Skinner (1981) who said that: 1) cluster analysis should be based on a theory of the nature of the disorder, which implies to us that the theory specify the number of groups to be derived in advance; 2) that the clusters be subjected to a close scrutiny for internal consistency and validity and external validity. External validity has to do with whether the groups differ significantly on outcome measures not used in the original cluster analysis. Internal validity refers to the internal consistency of the clusters and to whether the clusters can also be derived by different cluster methods. We derived three subtypes: pure ADD not hyperactive (N=49), ADDH (N=63 boys ADD and hyperactive), and ADDHA (47 boys ADDH and aggressive). This cluster analysis was based entirely on white males: there were insufficient subjects to look at sex and race differences. We further divided the subjects into those who did and did not satisfy criteria for LD and found that the percentage of LD children in each of the three groups was similar (about half in each group by our criteria). It is important for the reader to bear in mind that our study was based on children referred to our clinics for evaluation and treatment; it was not an epidemiological sample where the overlap with LD and other psychiatric disorders is less than in referred groups.

We did not attempt to check internal consistency via various clustering techniques to see if they would converge on a common solution. We know from experience that a common consensus via this method is difficult to achieve. We approached the matter differently, using cut scores on the original

variables to define the clusters. We were able to duplicate the clusters almost perfectly by doing this; only a few "outliers" remained.

We had a variety of measures supporting the external validity of the three groups. The three groups were significantly separated by teacher ratings other than those used to perform the cluster analysis. The ADDHA group differed from the ADD only (without hyperactivity and aggression) in socialization skills, impulsivity, and the impatient/aggressive traits associated with the Type A personality (Matthews and Angulo, 1980). Parents rated the ADDHA group higher on the externalizing scale of the Child Behavior Checklist (Achenbach and Edelbrock, 1983), but the groups did not differ on the internalizing scale. Nor did the groups differ on self-ratings on the Junior Personality Inventory (Eysenck et al., 1970). However, physiological data supports the existence of the three subtypes (see Section 6 below).

There are studies other than those of Loney and associates which suggest the validity of an ADHD plus aggressive subtype (Atkins et al. 1989; Campbell and Paulauskas, 1979; Johnston and Pelham, 1986; Pope et al. 1989, Whalen et al. 1979). Pelham and Bender (1989) noted that over half of ADHD children have significant problems in relating to peers, which may be, in part, due to aggressiveness. Aggression is more often a characteristic of male than female hyperactive subjects (Landau and Milich, 1988; Pelham and Bender, 1982).

3.14 Summary/Critique.

Until DSM-IV criteria are finalized and gain acceptance, it seems best to define ADD children much the same way they are defined in DSM-III-R, recognizing that many of these children will have other diagnoses, mainly conduct/oppositional disorders, anxiety disorders including separation anxiety, and depression. We recommend the DSM-III-R criteria as a first stage screening process because they identify a heterogenous sample which can then via more refined measures be grouped into more homogeneous subtypes; e.g., with or without hyperactivity, with or without aggression, and with or without specific cognitive defects. Both the DSM-III and DSM-III-R diagnoses should be used co-jointly, however, in choosing children for research projects; i.e., subjects chosen should satisfy the criteria of both manuals and for some projects the research criteria of Swanson described in Section 3.11 above. Moreover, we believe that the diagnosis of ADD/ADHD should be restricted to children with IQs above 70 who have no definable neurological disease (although nearly all will have soft and some even hard neurological signs) and who are not schizophrenic or autistic. We concur with the statement in DSM-III-R which we interpret as meaning that ADHD may be a result of mental retardation:

> "In mental retardation there may be many features of ADHD because of the generalized delay in intellectual development. The additional diagnosis of ADHD is made only if the relevant symptoms are excessive for the child's mental age" (p. 52).

The IQ cutoff for a diagnosis of mental retardation in children is 70 on an individually administered intelligence test. It is suggested that children in the IQ range of 70-90, who satisfy all criteria for ADD/ADHD be given some qualifying label such as Typical ADHD or Prototypical ADD; the group with IQs greater than or equal to 90 might be called Atypical or Infrequent ADD. The prototypical group may be the majority of ADHD children when diagnostic criteria are applied uniformly to children of all social classes and races. In the MBD era it was felt that most children labeled MBD were near average, average, or above average intelligence. This has also been reported for ADD/ADDH children (Zarski et al., 1987). Unfortunately, good epidemiological studies classifying ADD/ADHD

children by race, age, and IQ are not available. The major purpose of any definition is to have sufficient information to be able to classify a child in ways that satisfy present and anticipated DSM criteria as well as educational criteria. While this is somewhat of a guessing game, it is unlikely that the behavioral items which appear on various well standardized rating scales and structured interviews will not accomplish this objective.

4.0 Epidemiology.

Shaywitz and Shaywitz (1992) say, in the introduction to their book, that ADD in now recognized as the most common neurobehavioral disorder of children. It affects children from earliest infancy through school and into adult life. According to this article, estimates for ADD with or without hyperactivity range from 10 to 20% (see Shaywitz and Shaywitz, 1988). DSM-III-R estimates the prevalence of ADHD to be much lower (3% or 1.25 million children). Shekim et al. (1990) state that symptoms of ADD/ADHD persist into adulthood in one-third to one-half of all subjects receiving this diagnosis in childhood. And according to this same article, the overwhelming majority of adult subjects have some other comorbid diagnosis.

A problem that has not been given adequate attention is that of diagnosing ADD/ADHD reliably in the preschool years. Palfrey et al. (1985) evaluated children at eight checkpoints between birth and kindergarten. Overall, 13% of the children met criteria for possible ADD/ADHD at one or more checkpoints. However, only 5% of the group evidenced definite symptoms which persisted into kindergarten. The peak age for the identification of symptoms was 3.5 years. It is obviously dangerous to make a diagnosis of ADD/ADHD in the preschool years, since many young children demonstrate behaviors associated with this condition which are in fact normal for their age. We simply do not have any reliable information on the prevalence of ADD/ADHD in preschool children.

It is clear that we can make the prevalence as low as we wish by imposing restrictive criteria, but this may exclude children who need help. There is an inverse relation between prevalence and the severity of restrictive diagnostic criteria. Moreover, we have not solved the problem of how to diagnose ADHD or LD in families living in poverty or near poverty. Symptoms of restlessness will occur in many children who for one reason or another are not adequately prepared for school or who are not motivated to learn. The two tables below summarize data from prevalence studies in the U.S. and abroad.

4.1 TABLE

U. S. studies presenting prevalence rates for Attention Deficit Disorder or Hyperactivity.

Study	Measure	Sample	Prevalence
Velez, C.N.; Johnson, J.; Cohen, P. (1989)	Diagnostic Interview Schedule for Children Child and Parent forms (DISC & DISC-P)	776 children age 9-18 years selected at random from census tracts in two counties in New York State interviewed in 1983 and again in 1985.	TIME 1 (1983): Age 9-12, Rate 16.6; Age 13-18, Rate 9.9. TIME 2 (1985): Age 11-14, Rate 12.8; Age 13-18, Rate 6.8
Epstein, M. H.; Cullinan, D.; Gadow, K. D. (1986)	Conners' Abbreviated Teachers Rating Scale (ATRS)	482 children age 6-18 years attending public schools in northern Illinois who had not received a previous diagnosis.	Age 6-11: male N 221, Rate 4.4; female N 172, Rate 3.5. Age 12-18: male N 49, Rate 8.2; female N 40, Rate 5.0
Stewart, M. A.; Cummings, C.; Singer, S.; DeBlois, C.S. (1981)	Clinician interview with the mother; mother, father, and teacher ratings on questionnaire.	216 children age 3-16 (90% were 5-14) admitted to the University of Iowa Child Psychiatry Clinic and Ward with I.Q. greater than 55 and no continuing medical or neurologic disorder.	male: N Hyper. 58, Rate 26.8; female: 9, 4.1; total: 67, 31.0
Ullmann, R.K.; Sleator, E.K.; Sprague, R.L. (1985)	Conners' Abbreviated Teacher Rating Scale (ATRS)	732 children grades 2-3 attending school in Danville, IL.	Rate*: males 24.0, females 12.7, Other 6.0, Total 18.4. Rate: White 16.5, Black 27.5. (* These rates were calculated using the accepted cut-score of 15, but the mean ± 2 SD yielded rates between 1.7 and 3.2 with cut scores ranging from 24-27.)
Sprague, R.L.; Cohen, M.; Werry, J.S. (1974)	Conners' Abbreviated Teacher Rating Scale (ATRS)	291 children grades K-6 attending public school in the Champaign-Urbana, IL area. (Those previously identified as hyperactive were excluded from this study.)	Gender: male N Hyper. 26, Rate 9; female 6, 2

TABLE 4.2

International studies presenting prevalence rates for Attention Deficit Disorder or Hyperactivity.

Country	Study	Measure	Sample	Prevalence
U.S.A. & China	Yao, K.; Solanto, M.; Wender, E. (1988)	Conner's Abbreviated Teacher Rating Scale (ATRS) and Conners' Teacher Rating Scale (TRS) Hyperactivity Factor	250 children in grades 1-6 attending a public school in New York City's Chinatown. Sample was comprised of newly immigrated Chinese and Chinese-American students.	**ATRS** Gender / Rate male 8.76 female 1.72 all Ss. 6.0 **TRS Hyperactivity Factor** Gender / Rate male 12.7 female 1.72 all Ss. 7.6
Italy	O'Leary, K.D.; Vivian, D. (1985)	Conners' Abbreviated Teacher Rating Scale (ATRS) and Conners' Teacher Rating Scale (TRS) Hyperactivity Factor	344 children grades 2-4 attending one of 14 elementary school in the Veneto and Lombaria regions of northern Italy.	**ATRS** Gender / Rate male 4.7 female 5.7 all Ss. 5.8 **TRS Hyperactivity Factor** Gender / Rate male 4.8 female 6.3 all Ss. 7.6 (prevalence rates based on the mean of the factor score + 2SDs).
India	Bhatia, M.S.; Nigam, V.R.; Bohra, N.; Malik, S.C. (1991)	Diagnostic and Statistical Manual - 3rd edition (DSM-III) criteria for ADDH.	1000 children age 3-12 who attended the pediatric outpatient department at Kalawati Saran Children's Hospital in New Delhi.	*Total Subjects* / *Subjects with ADDH* *Male* / *Female* / *Total* Age (N) / N / Rate / N / Rate / N / Rate 3-4 364 17 7.9 2 1.4 19 5.2 5-6 278 26 14.8 2 1.9 28 10.0 7-8 198 17 16.7 3 3.1 20 10.1 9-10 112 25 29.8 6 21.4 31 27.7 11-12 48 11 32.4 3 21.4 14 29.2 total 1000 96 15.7 16 4.1 112 11.2
Canada	Love, A.J.; Thompson, G.G. (1988)	Diagnostic and Statistical Manual - 3rd edition (DSM-III) criteria, Thompson-Patterson Scale for Psychosocial Development (structured interview), Stanford-Benet Intelligence Scale	116 children age 2.8-7.7 years with a mean age (± SD) of 5.0 (± .9 yr) who attended the West End Creche Child and Family Clinic with suspected serious psychiatric problems.	Gender / Rate (N) males 57.7 (67) females 15.5 (18) total 73.3 (85)

Country	Study	Measure	Sample	Prevalence
Canada	Offord, D.R.; Boyle, M.H.; Fleming, J.E.; Blum, H.M.; Grant, N.I.R. (1987)	Child Behavior Checklist and interviews with child and parents.	2674 children age 4-16 selected randomly using the 1981 Census for Ontario, Canada.	Age / Males / Females 4-11 / 10.1 / 3.3 12-16 / 7.3 / 3.4 4-16 / 8.9 / 3.3
New Zealand	McGee, R.; Partridge, F.; Williams, S. ; Silva, P.A. (1991)	Mothers' report of "easy to manage" to "very difficult to manage" and an adaptation of the 4 dimension scale developed by Shaffer et al. (1983) in which each dimension is rated 1 to 5 with 5 being most severe.	1024 children used in the Dunedin Multidisciplinary Health and Development Study, born in Dunedin's Queen Mary Hospital between April 1, 1972 and March 31, 1973 and followed from age 3-15.	Subjects received the diagnosis "hyperactive" only if they scored above a 15 on the Shaffer et al. scale *and* were rated as "difficult to manage" by S's mother. N / Rate scored > 15: 113 / 11.0 scored > 15,but not hyperactive: 92 / 9.0 hyperactive: 21 / 2.1
New Zealand	Werry, J.; Hawthorne, D. (1976)	Conners' Abbreviated Teacher Rating Scale (ATRS)	418 children age 5-12 in elementary schools who were selected by having teacher rate the first boy and first girl after the letter "N" on the roll.	Cut-off score* / Rate based on cut-off: *Males* / *Females* 15: 22 / 9 21: 5 / 4 (* A cut-off score of 15 identifies in a U. S. population Ss that are two SD above the mean for the ATRS, but for a New Zealand population two SD above the mean requires 21 as a cut-off score.)
Australia	Holborow, P.L.; Berry, P.; Elkins, J. (1984)	Conners' Abbreviated Teacher Rating Scale (ATRS), Queensland Scale adapted from Davids (1971), Pittsburg Adjustment Scale (all three were rated by teachers)	1908 children in grades 1-7 in six State Primary Schools in Australia	Scale used / N sample / N hyp. / Rate ATRS / 1759 / 99 / 5.6 Queensland / 1593 / 119 / 7.5 Pittsburg / 1908 / 169 / 8.9 Conners and Queensland / 1580 / 68 / 4.8 Queensland and Pittsburg / 1593 / 82 / 5.1 Pittsburg and Conners / 1759 / 63 / 3.6 All three scales used / 1580 / 55 / 3.5

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Country	Study	Measure	Sample	Prevalence
Germany	Sprague, R.; Cohen, M.; Eichlseder, W. (1977)	Conners' Abbreviated Teacher Rating Scale (ATRS)	5357 children age 5-12 in elementary schools in Munich.	Cut-off score* / Rate based on cut-off: Males / Females 15: 12 / 5 18: 6 / 3 (* A cut-off score of 15 identifies in a U. S. population Ss that are two SD above the mean for the ATRS, but for a German population two SD above the mean requires 18 as a cut-off score.)
England	Goodman, R.; Stevenson, J. (1989)	Mother, father, and teacher reports on the Rutter Behavior Questionnaire.	570 13-yr-old twins (285 pairs) born in London between 1967-68. Only 498 Ss received both parent and teacher ratings and were given a hyperactivity category.	Male: N / Rate; Female: N / Rate Hyperactivity Category Home only N=63: 33 / 6.9 / 30 / 6.0 School only N=36: 22 / 4.4 / 14 / 2.8 Pervasive N=23: 16 / 3.2 / 7 / 1.4
England & Scotland	Rutter, M. (1967)	Children's Behavior Questionnaire developed by Rutter for completion by teachers.	*Sample 1.* 86 subjects randomly selected from general population of Aberdeen; 34 children attending psychiatric clinic at The Hospital for Sick Children, Aberdeen; 75 children in clinic at The Maudsley Hospital, London. *Sample 2.* 200 subjects from Aberdeen general population and 84 selected from The Maudsley Hospital. All Ss. were age 9-13.	Male: N / Rate; Female: N / Rate Sample 1. Aberdeen-gen. pop.: 55 / 10.9 / 31 / 3.2 Aberdeen-clinic: 22 / 77.3 / 12 / 50.0 Maudsley Hosp.: 46 / 87.7 / 29 / 72.1 Sample 2. Aberdeen-gen. pop.: 100 / 9.0 / 100 / 5.0 Maudsley Hosp.: 45 / 68.8 / 39 / 69.1

4.2 Summary/Critique.

It is reasonably clear that the number of children we classify as ADD/ADHD is related to the stringency of definitional criteria. What is missing are good epidemiological studies of distribution by social class, sex, and urban-rural samples in all regions of the U.S. These should be done with well trained interviewers using some instrument such as the DISC-P-R on stratified random samples of children in the U.S.

5.0 Etiology.

This section considers the possible causes of ADD/ADHD. This area overlaps a subsequent section on comorbidity (Section 8).

5.1 Lead and Related Agents.

A number of papers have suggested a relationship between hyperactivity and blood lead levels (Baloh et al. 1975; Chaiklin et al., 1985; Mirsky, 1987; Needleman, 1985; Rimland & Larson, 1983; Schroeder & Hawk, 1987; Thompson et al., 1989; Walker,; Weiss, 1985; Winneke et al., 1989; Yule et al., 1984). However, in a very good review of the literature, Furgusson et al., (1988) conclude that the relationship between lead and hyperactivity is trivial or negligible. We believe it fair to say that the relatively low levels of lead many children are exposed too is not a major cause of ADD/ADHD. The greatest exposure to lead is children born in low socioeconomic status families, and it is difficult in these cases to do studies that clearly separate genetic and environmental factors. It is not difficult to imagine, however, that lead or other toxic agents in sufficient quantity could closely mimic genetic effects. This would not explain the majority of ADHD cases who come from families in which exposure to lead is trivial or the variation in symptomatology in families with equivalent levels of lead exposure.

There are factors that are known to be associated with a wide range of postnatal defects including hyperactivity (see below). The majority of these defects are initiated in utero (Phoenix et al., 1959). Low birth weight and preterm birth have been cited as etiological factors in a number of studies (Astbury et al., 1987; Szatmari et al., 1990). The mother's nutritional status prior to pregnancy can adversely affect the growth of the fetal organs, including the brain (Frank, 1984).

Acute central nervous system infections, especially bacterial meningitis, can cause cognitive impairment, specific learning disabilities, and attention deficits, both through direct effects on the brain and hearing loss (Sell, 1987). Also, children who experience hypoxia, as a result of acute respiratory illness, suffocation or near-drowning (Pearn, 1977) may have subtle but lasting brain dysfunction. Another factor of possible importance is anemia resulting from iron deficiency. Soemantri et al. (1985) report that anemic children supplemented with iron for three months did not catch up with non-anemic children in academic achievement.

5.2 Food Additives.

Feingold (1975) wrote a book entitled "Why is Your Child Hyperactive" in which he attributed hyperactivity to food additives. The presumed culprits were salicylates, food dyes, and preservatives, and the putative association between food additives and hyperactivity is referred to in the literature as the Feingold hypothesis. Unfortunately for Feingold, the hypothesis could not be verified (Conners, 1980; Mattes, 1983; Taylor, 1980). Kavale (1983) did a meta-analysis of 23 studies investigating the Feingold

hypothesis; results were clearly negative to the hypothesis. It may be, however, that for some highly selected groups of children, dietary factors may trigger an allergic/immunological response (Egger et al., 1985).

5.3 Sugar.

The food additive hypothesis was succeeded by the sugar hypothesis, which asserts that sugar increases activity and may cause ADD/ADHD (Smith, 1975). Studies of the relationship of sugar to activity have been conducted and none of them support the sugar hypothesis (Gross, 1984; Milich et al., 1986; Milich and Pelham, 1986; Wolraich et al., 1985). Indeed, Milich et al. claim that sugar is as likely to reduce as to increase activity.

5.4 Alcohol and Substance Use.

Results are clear in showing that women who consume alcohol during pregnancy are more likely to have offspring with symptoms of ADD/ADHD as well as other more profound defects (Abel, 1984; Brown, 1991; Holzman, 1982; Nanson and Hiscock, 1990; Steinhausen et al., 1983a, 1983b; Streissguth and Giunta, 1988). Papers by Alterman and associates (Alterman, 1985; Alterman et al., 1982) suggest that alcoholics reporting a substantial number of symptoms of MBD/hyperactivity in childhood may represent a subgroup within the larger population of alcoholics. Also, subjects high in MBD/hyperactivity tend to suffer more adverse effects as a result of drinking than subjects low in MBD/hyperactivity. And it has been thought by some that growing up in an alcoholic family is sufficient to produce ADD/ADHD (Berlin, 1989; Manshadi et al., 1983). Goodwin (1983) and Pihl et al., 1990) discuss evidence indicating that alcoholism runs strongly in families and that the illness may have a genetic component. Pihl et al. note that sons of male alcoholics are commonly described as conduct disordered and hyperactive. It is perhaps truistic but important to say that alcoholism in the home does not inevitably lead to serious pathology in the children. West and Prinz (1987) in a very good review article make the point that only a minority of the children reared in alcoholic homes develop a childhood psychological disorder.

It has been recognized in recent years that drugs other than alcohol can result in severe physical and behavioral problems including ADD/ADHD (Bukstein, 1989; Merrick, 1985; Milin, 1991; Van Dyke et al., 1990).

5.5 Health and Associated Problems.

Several authors have found that ADHD children have more health problems than normal controls (Hartsough and Lambert, 1985; Mitchell et al., 1987; Stewart et al., 1966; Trites, et al., 1980; Szatmari et al., 1989). The finding of a greater number of allergies among hyperactive children has received mixed support. Trites et al. said yes, but Mitchell et al. said no. It may be that health problems are a correlated (pleiotropic) factor but not a causative factor of ADD/ADHD. We need studies here again, however, that adequately control for relevant socio-economic factors.

Pediatricians in our own hospital in working up ADD/ADHD children look for various organic/medical problems as follows: hyperthyroidism, seizures/migraine headaches, hearing/visual deficits, pinworms, toxic conditions including substance abuse and medications such as theophylline, caffeine, antihistamines, phenobarbital/anticonvulsives. It is not unusual for children treated with phenobarbital to exhibit symptoms of hyperactivity, which commonly results in the discontinuance of

medication and/or the substitution of another medication. Other comorbid medical conditions that should be considered in assessment are anemia, Tourette's/Tic Disorder, Sydenham Chorea (streptococcal infections), Wilson's Disease, brain tumor, and acquired brain injury (see Herskowitz and Rosman, 1982).

Related to the issue of allergies is the immunoreactive theory of Gualtieri and Hicks (1985), which among other things attempts to explain the preponderance of male developmental problems. The essential elements of the theory are: 1) males are more frequently afflicted than females but their disorders are less severe than the comparable disorders in females; and 2) disorders of females depend more upon genotype than is the case for males (less environmental influence for females than males). The writers hypothesize that something about the male fetus results in an unfavorable uterine environment--a factor that induces a state of maternal immunoreactivity. If this is true, then birth order would be important; that is, because of sensitization of immunological factors the incidence of disorders such as hyperkinesis should be greater for second and third born than for first born children. In mixed support of the theory, Ackerman et al. (1988) found that males in diagnostic groups implicating primary cognitive dysfunction had antecedent brothers more frequently than males in diagnostic groups manifesting behavioral and emotional problems. Males with diagnoses of attention or anxiety/affective disorders were more frequently first born than those with cognitive disorders (learning disorders).

5.6 Family Functioning and Conflict.

A large number of studies implicate family problems as a possible cause or modifier of MBD/ADD/ADHD (Barkley et al., 1991; Beck et al., 1990; Befera and Barkley, 1985; Brown, 1982; Breen and Barkley, 1988; Brown and Pacini, 1989; Campbell, 1986; Cantwell, 1988; Cunningham et al., 1988; Danforth et al., 1991; Lambert, 1987; Lin, and Tang, 1985; MacDonald, 1989; Mash and Johnston, 1983, 1990; Marshall et al., 1990; Schachar et al., 1990, 1991; Talmadge, 1983). The general picture that emerges from these studies is that parents of ADHD children are more likely to be abusive, alcoholic substance users, and/or have some other relatively serious psychopathology. Moreover, as a group, these parents are likely to have fewer contacts with their children, contacts that are shorter in duration, and contacts that are ambiguous. Lahey et al. (1988, 1989) report data linking maternal and paternal personality traits to conduct disorder but not to ADD with hyperactivity. Children whose fathers had both ADD with hyperactivity and conduct disorders were, however, more apt to be overly aggressive and law-breaking.

In reviewing this literature, Barkley (1990) makes the point that ADHD generates family conflict. Barkley thinks that much of this is due to inattentive, impulsive, and overactive behaviors of ADHD children, which all too often conflict with the demands of parents. Barkley further notes that in play situations with their sibs or others, particularly when cooperation is required, ADHD children are less willing to wait their turn or play by the rules. The notion that family dysfunctioning may be caused by ADHD children is clearly evident in that these children elicit negative reactions from almost everyone with whom they come in contact (Cunningham and Siegal, 1987; Whalen et al., 1980). Barkley notes further that when ADHD children are placed on stimulant medication, the behavior of their mothers changes significantly in the direction of a more normal relationship (Barkley and Cunningham, 1979, Cunningham and Barkley, 1978; Barkley et al., 1984; Humphries et al., 1978). In our clinics, we often see parents who disagree and even some who argue violently over the issue of how best to manage their ADHD child. It is clear in watching parent-child interactions that a substantial part of the disagreement may be directly attributed to the child. Barkley states that he has clinically witnessed, as we have, parents who have attained what might be called a state of parenting "learned helplessness."

Much of the research in this area is confounded by uncontrolled background factors such as parental education and occupation. Velez (1989) reported that low paternal education and low maternal education are related to the occurrence of ADD/ADHD. Bhatia et al. (1991) found that ADHD was more common in first born children and in children from the lower socioeconomic classes. It is fair to say that family factors do contribute to the severity of symptoms, noting that the interactions are a multi-way intersection involving the afflicted child (proband), sibs, parents/caregivers, and teachers. It seems best to conclude from the evidence we now have that the major cause(s) is (are) inherited biological factors, which the family and school environments may intensify or lessen depending upon their nature and the genetic makeup of the child.

5.7 Genetic Factors.

Of the many studies in this area, among the best are those by John DeFries, Bruce Pennington, and colleagues at the University of Colorado and those of Jim Stevenson and associates in England. Gillis (1992) used a sophisticated regression model developed by DeFries and Fulker (1985, 1988) to estimate the heritability of ADHD. Subjects were 37 pairs of monozygotic (MZ) and 37 pairs of dizygotic (DZ) twins. At least one member of each pair of twins had a reading disability (RD) and at least one member of each pair, not necessarily the one with RD, satisfied criteria for ADD as diagnosed by the DICA-P (Diagnostic Interview for Children and Adolescents, parent form developed by Herjanic et al., 1982 version). Probandwise concordance rates for ADHD were 79% for MZ and 32% for DZ twins. Age was not a significant predictor of DICA-P scores; i.e., the heritability (h^2) of ADD as diagnosed by the DICA did not vary with age. The heritability coefficient was very high (0.98); i.e., nearly all the variance in DICA-P scores was attributed to heredity (coefficient varies from 0 to 1.0). It was concluded that hyperactivity symptoms as expressed by the DICA are highly heritable.

Gilger et al. (1992) provide evidence suggesting that in some cases reading disability and ADHD may occur together because of a shared genetic etiology (an important type of comorbidity). Twins were studied in which at least one member of each pair was reading disabled and in which at least one member was also ADHD, not necessarily the same member for both conditions.

Stevenson (1992) studied the heritability of activity level as rated by mothers and teachers on two measures of attention in a sample of 91 MZ and 105 DZ pairs. This was an epidemiological sample (representative of twins in the general population). The twins were recruited from hospital birth records in five London boroughs and from a search of the registers of schools in the London Area. The twins were tested on a measure of sustained attention (checking a page of letters for the letter "e") and on a battery of cognitive measures which included the Wechsler Intelligence Scale for Children-Revised (WISC-R) and reading and spelling achievement tests. Two measures of attention were derived, freedom from distractibility (FFD) from the WISC-R and "e" scan attentiveness (ESA) from the letter identification task. The FFD measure was derived from the distractibility factor of the WISC-R: sum of the scores on three subtests (arithmetic, digit span, and coding) converted to z-scores. The Rutter scales (Schachar et al., 1981) were used to rate hyperactivity.

Only two of the measures received a significant heritability coefficient, the mother's ratings of hyperactivity (heritability= 0.75) and the ESA (heritability=0.76). The author states that these results are consistent with the idea that genetic factors influence both the behavioral and attentional aspects of hyperactivity.

Genetic studies may play an important role in helping us to identify subtypes of ADHD children. One recent study that bears on this point (Stevenson et al., submitted manuscript) identified a small subgroup of ADHD children who had a spelling defect. It is generally recognized that spelling deficiencies by and large occur independently of ADHD. However, there appears to be a subgroup in which these two phenotypic traits are regulated by the same genes. The authors do not discuss the genetic mechanism underlying this coupling, and simply say that common genetic factors contribute a substantial degree to the observed comorbidity of ADHD and spelling disability.

Stevenson et al. studied spelling rather than reading on the supposition that spelling disability is an index of broader deficits in literacy. Moreover, a previous study by this same group had not found a significant genetic relationship between reading and ADHD (Gilger et al., 1992). However, in the Gilger et al. study, reading disability was defined by a one standard deviation discrepancy from IQ, and in the Stevenson et al. paper the cutoff for spelling was 1.5 standard deviations (i.e, a considerably more severe discrepancy score). In any event, it is important to note, as Stevensen et al. do, that supposition of a common genetic factor applies to ADHD children who have a severe orthographic problem. Cantwell & Baker (1991) argued that ADHD could lead to learning disabilities, and the overlap is appreciable as many studies show (Dykman et al., 1985; Shaywitz and Shaywitz, 1992). But, causation could go in the opposite direction.

The Stevenson et al. study, was based on two twin samples, one from London (N=190 pairs) and one from Colorado (N=260 pairs). The proportion of ADHD probands that also had a spelling disability was 24% and the proportion of spelling probands that were ADHD was 30%. The differences between these two estimates is not statistically significant, which lends credence to the supposition that there is a subgroup of children in which both spelling and ADHD are influenced by a common gene or genes. The almost equal 2-way percentages in this study are contradictory to the general impression that while ADHD can "cause" LD the reverse is less likely (McGee et al., 1989).

There are a number of other studies pointing to the importance of heredity. Familial risk for ADD/ADHD and antisocial behaviors is higher among the relatives of children who have a conjoint diagnosis of both ADD/ADHD and Conduct Disorder than among the relatives of children who are only ADD/ADHD (Biederman et al., 1987a, 1987b; Sandberg et al.,1978; Faraone et al.,1991; Stewart et al., 1980; Singer et al.,1981). Faraone et al. (1991b) found that the family members of probands with ADHD and Oppositional-Defiant Disorder had a higher risk for ADHD and Conduct Disorders than the family members of probands with ADHD alone. However, the risk was lower for "familial spread" than in a group who were comorbid for both ADD/ADHD and Conduct Disorder. Biederman et al. (1990) report data strongly suggesting that ADHD and Major Depressive Disorder share common familial vulnerabilities: the risk of Depression among the relatives of ADD/ADHD subjects was considerably higher than the risk of Depression among the relatives of normal controls. And in another article Biederman et al. (1991) report an association between Anxiety Disorders and ADD/ADHD: the risk of Anxiety Disorders among the relatives of ADD/ADHD children was higher than that for the relatives of normal children.

At a more molecular level, the length of the long arm of the Y chromosome has been found to correlate with psychiatric symptom severity, hyperactivity, parental psychopathology, and paternal alcoholism (McConville, 1983). Deutsch et al. (1990) found that ADHD children tend to have more anatomical stigmata than normal children. This over representation of dysmorphology was also found in the first degree relatives of ADHD children. These findings suggest that the dysmorphology and ADHD (another form of phenotypic comorbidity) may be explained by an autosomal dominant mode of

inheritance. Elsewhere, Deutsch and Kinsbourne (1990) say that genetics may reveal natural subgroups of ADD children and provide a groundwork for a biochemical breakthrough.

Albert-Corush et al. (1986) compared 176 biological and adoptee parents of hyperactive and normal children. The biological parents of hyperactive children described more attentional problems than the biological parents of normal children but the two groups of parents did not differ in ratings of impulsivity. Frick et al. (1991) studied 177 outpatient boys with ADHD or conduct disorder (CD). The fathers, mothers, and other relatives of the ADHD children were also more apt to have a history of ADHD but not CD. Hence, the two disorders appear to be independent (see comorbidity section). Bregman et al. (1988) associate hyperactivity, impulsivity, attention deficits, and anxiety with the fragile-X syndrome. These results are based on only 14 males covering a wide age-range of 3 to 27 (see also Bregman et al., 1987; Kerbeshian et al., 1984; Nielson, 1983).

Genetic studies of dyslexia are relevant to this section inasmuch as dyslexia frequently overlaps ADD/ADHD. Pennington et al. (1991) studied 204 families (1698 individuals) from rural and suburban communities of Washington State and Colorado. A computer program called POINTER was used to study segregation in the relatives of dyslexic probands. The results were consistent with a hypothesis of major locus (dominant) transmission in three of four samples and with polygenic inheritance in the fourth. The estimated gene frequency of the major locus was 3 to 5%. The familial risk for dyslexia appears to be very high; i.e., given a first degree dyslexic relative (e.g., father), the probability of another first degree relative (e.g., son) having dyslexia is 35 to 45%).

5.8 Summary/Critique.

Of the various possible causes of hyperactivity, genetic factors have received the most support. From our point of view, the most likely mode of transmission considering the heterogeneity of the disorder is that of major gene inheritance, although nothing is known at present about the mode of inheritance. We believe that impulsivity and inattention are separate traits, each shaped separately by one or at most a few major genes. A given individual comes into the world with a liability to manifest separately one or more of the components of ADHD (impulsivity, hyperactivity, and inattention). The genes may be linked or exist in some sort of epistatic relation to each other. But since the traits of impulsivity and hyperactivity tend to occur together, it is possible that they depend upon exactly the same genes. This is suggestive of a pleiotropic genetic effect in which a single gene has two or more effects as is the case in phenylketonuria (PKU). Attentiveness may also be a pleiotropic factor, but it appears to be relatively independent of hyperactivity; inattentiveness is common to learning disabilities (Dykman et al., 1971) and many other conditions in which there is not excessive activity. We emphasize, however, that what has just been said is speculation; the mode of inheritance is not clear. There are many environmental factors that play a role in shaping inherited predispositions, and some of these such as lead poisoning could mimic the effects of inheritance. The family literature reviewed above (Section 5.6) suggests that the way parents relate to each other and their children plays a role in shaping the behavior of ADD/ADHD children without being a primary cause; i.e., genetic predispositions may be altered to a variable degree depending on the "strength" of genetic factors.

6.0 Biological Studies and Theories of ADD/ADHD.

Quay (1988) speculates that ADHD, conduct disorder (CD), and anxiety-withdrawal disorder (AW) can be differentiated in terms of Gray's theory of two interesting control systems: a Behavioral Inhibition System (BIS) and a Behavioral Reward System (REW). In Gray's theory, increases in

responding brought about by positive reinforcement ("hope") and by both active avoidance and escape paradigms (reward is escape from punishment or "relief") are under the control of REW. Reductions in responding that occur in extinction procedures and passive avoidance are under the control of BIS. Anxiety is activity in the BIS that is cued by conditioned stimuli that signal fear or frustration. Predatory aggression, on the other hand, is under the control of REW. Gray has postulated anatomic loci for these two systems: the reward system corresponds to the catecholaminergic structures mediating the rewarding effects of self-stimulation of the brain (Olds and Fobes, 1981). The BIS, a supposed noradrenergic system, is localized in the lateral and medial septal areas and in the connections of these to the hippocampus.

Stimulant drugs enhance the activity of both REW and BIS. Quay speculates that there is a relatively greater enhancement of BIS than of REW in ADHD children given stimulant medication, thus bringing the two systems into balance. He concludes that ADHD children have a deficient BIS, noting that antianxiety medications tend to affect them adversely. But because amphetamine improves passive avoidance but does not improve condition disorder (CD) and because there is suggestive evidence that catecholamine antagonists (haloperidol and propranolol) decrease CD, Quay suggests that CD seems most related to oversensitivity to reward. He attributes anxiety/withdrawal disorders to an overactive BIS. Gray's two systems are supported by a considerable amount of experimental evidence and the extrapolations of Quay appear to be very reasonable. In particular, autonomic studies of heart rate and skin conductance reactivity suggest that hyperactive children are more difficult to arouse than normal children which supports Quay's notion of an underactive BIS (see Section 6.6 below).

6.1 Biological Theories of Attention.

Posner (1988) has developed a neurological model of attention that emphasizes the role of attention in human information processing. He describes two neural systems: a posterior or "bottom-up" system involved in the representation and processing of sensory information and an anterior or "top-down" system involved in the representation and processing of action plans. Much of the research of Posner and his colleagues has focussed upon the posterior system using a visual orienting response.

Target stimuli are presented in either the left or right visual fields and these are cued by warning stimuli which may also occur in either visual field. Subjects press a reaction time (RT) key whenever they see a target, and reaction time is slower when the cue signals a target appearing in a different visual field. There are three type of cues: neutral (no cue), valid (cue and target in same visual field), and invalid (cue in different field than the target). The majority of trials involve a valid cue, which enhances the effectiveness of the invalid cue when it occurs. The targets are presented under two different delay conditions, 100 and 800 msecs.

The posterior attention system is not localized to a single area of the brain. Posner describes several elementary operations: disengagement, movement, and engagement of attention. All of these must be intact for normal functioning of the posterior system, and each is presumed to be controlled by a specific brain area: ieft posterior parietal lobe for disengage function, midbrain for the move operation, and thalamus for the engage operation (Posner et al, 1982; 1984; Rafal and Posner, 1987). Defects are measured in terms of right/left differences in times a) to respond to an invalid cue (disengage); b) to respond to a valid cue (move or validity effect); and c) to respond to both valid and invalid cues (engage).

Tucker and Williamson (1984) published a very good article summarizing both animal and human studies of attentional processes. Like Posner, they also proposed two systems, different, however, from

those of Posner. The first, referred to as an activation system, that is believed to be lateralized on the left side of the brain, and is associated with dopamine functioning. Tonic activation depends upon a specific structure (the striatum), which produces a state of motor readiness and sequences motor acts involved in goal directed behavior. This is conceived as a vigilance system. The other system, the arousal system, is responsible for phasic response to perceptual input. It is considered to be lateralized on the right side of the brain and is neurochemically related to norepinephrine. Activation of this system decreases background noise, enhancing the signal to noise ratio, and it is presumed to be involved in orienting to novel stimuli.

Iversen (1984) describes the dorsal striatum as an area integrating information from sensory and association cortex, which is assumed not to be deficient in ADD/ADHD children (Swanson et al. 1990). But the ventral striatum mediates different functions; it links the limbic system to motor outputs. Dopamine is assumed to play an enabling or arousing role within the striatum, but is not essential for specific information processing (Iversen, 1984). Swanson et al. (1990) conclude that the role of the ventral striatum, including its contribution to motor output, may be pivotal in the search for the locus of a core attention deficit in ADD/ADHD.

Swanson et al. (1990), using the Posner paradigm, refute the idea that ADD/ADHD does not involve defects in attention. First, they believe that it is necessary to define a group of homogenous ADD/ADHD subjects, and they utilize the research criteria (RDC) described in the definition section. The child has to score very high on two of three ratings (teacher, parent, and child), and the ADD/ADHD condition must antedate any other comorbid disorder in development and must occur before the age of 7. Second, they believe that new models of attention not only explain their data but support the credibility of the attention deficit construct.

Swanson et al. hypothesized that ADD/ADHD children would exhibit a lateral difference in RT for the 100 msec invalid cue condition (a disengage operation), but that the lateral bias would be opposite to that which Posner (1988) reported for schizophrenic adults where RT was slower in the right visual field than in the left. This prediction was based on the fact that schizophrenic patients and ADD subjects are treated by medications which have an opposite effect on dopamine (DA agonists are used to treat ADD whereas DA antagonists are used to treat schizophrenia).

Overall, Swanson et al. found that ADD/ADHD children had longer response times than normals, which is typical for RT experiments, but the pattern of RT in the 100 msec cue condition was the same for both groups of children and matched the pattern reported by Posner (1988) for normal adults. While RT was faster in the valid than the invalid cue condition, as was expected, this did not differentiate ADD/ADHD and normal children. **This indicates that the posterior attentional system is intact--no defect in disengage, move, or engage.**

But as often happens in an experiment, a serendipitous finding emerged. Performance in the 800 msec condition was abnormal for ADD/ADHD subjects. Normal subjects did not show a lateral difference in RT in any condition. But in this condition ADD/ADHD subjects showed a lateral difference in RT (right visual field greater than left visual field) when attention was not focussed on the target (neutral and invalid conditions) but no lateral differences when attention was focussed on the target (valid cue condition). **Swanson et al. explained this as a defect in sustained attention mediated by the anterior system since the patterns of response did not match any of those postulated by Posner for the posterior system.**

The data of Swanson et al. suggest that ADD/ADHD children have difficulty in maintaining attention directed to a cue presented in the right visual field. Their use of sustained attention is different than that arising from an attenuation in vigilance tasks of rather long duration (Nuechterlein, 1983; Sykes et al. 1973; van der Meere and Sergeant, 1988). Here, sustained attention applies to a rapid dissipation of focussed attention which occurs over a very brief period of time (800 msecs). Moreover, this is a lateralized effect associated with the left hemisphere response to receiving the cue. The investigators say that:

> "...the failure of ADD/ADHD children to maintain attention for a relatively long period of time (seconds rather than msecs) may support the hypothesis of a right frontal deficit in ADHD children (see Voeller and Heilman, 1988). However, this pattern may be more apparent in those children who are 'hypoactive', or who receive a diagnosis of ADD (without H) or UADD (Lahey et al, 1987; Crinella et al. 1987)."

Swanson et al. (1990) go on to suggest that the literature on the pattern of performance deficits in ADD/ADHD children implicates the left lateralized, norepinephrine-mediated arousal system as the locus of the defect. Following the Tucker and Williamson (1984) theory, Swanson et al. suggest that ADD/ADHD children may be characterized by low dopamine-mediated activation and high norepinephrine-mediated arousal. The latter is assumed by Tucker and Williamson to be associated with sensory processing and the former with response variation and vigilance.

Heilman et al. (1991) noting that inattention, defective response inhibition, and impersistence are more commonly seen in adults with right than left hemisphere dysfunction propose because of the occurrence of similar symptoms in ADD/ADHD children that they also have a right hemisphere dysfunction. Other symptoms that ADD/ADHD children have which would implicate right hemisphere dysfunctioning are neglect of the left side and decreased activation of their right neostriatum. More specifically, because of the nature of the symptoms it is proposed that the dysfunction involves the right-sided frontal-striatal system. They further suggest that motor restlessness may reflect frontal lobe dysfunction due to impairment of the mesocortical dopamine system.

Patients with left-sided neglect not only fail to detect stimuli, but they also have difficulty in both focussing and shifting of attention (Rapscak et al., 1989; Posner et al., 1984). Heilman et al. (Heilman et al. 1991; Heilman et al. 1978) cite literature implicating the important role the right hemisphere plays in mediating attention, arousal, and motor activation. It is stated that because the right hemisphere can mediate attention in both fields, lesions of the left hemisphere play a minor role in attention and/or inattention.

To test this right hemisphere hypothesis, Voeller and Heilman (1988) tested ADHD subjects with a cancellation task in which subjects were instructed to cross out targets (letters or short line segments) on a sheet of paper. It was found that ADHD children exhibited the same kinds of neglect problems that adult patients with left spatial neglect from right sided lesions exhibit; i.e, both groups were more likely to ignore targets in the left than the right visual field. The writers (Heilman et al., 1991) cite references to support the following statement:

> "Several discrete anatomic areas appear to induce neglect when injured. These include the parietal lobe, the dorsolateral and medial frontal lobes (including the cingulate gyrus), the striatum, and portions of the reticular formation including the thalamus and

mesencephalon. It has been postulated that these areas form a distributed system that mediates attention, intention (motor activation), and arousal" (p. 77).

Heilman et al. (1991) also cite literature implicating the frontal lobes in inhibiting responses in go-no-go paradigms. Animal studies implicate the orbital or inferior lateral regions as playing an important role in inhibition. Dykman et al. (1970, 1971) had posited these same regions as playing an important role in ADD/MBD behavior. And, of course, Luria (1969 translation) had emphasized the role of the frontal lobes in inhibition and in intention.

The medial and lateral frontal lobes have extensive connections with the striatum, which includes both the putamen and the caudate nucleus. There are brain imaging studies indicating that ADHD children have a decreased regional blood flow in striatal areas (Lou et al., 1984). Heilman et al. (1991) conceive the striatum as a gating system which is important in its connections with the frontal lobes in translating volition into action (intention).

Finally, Heilman et al. liken the restlessness of hyperactivity children to akathisia which is seen as a side effect of some medications; i.e., uncontrolled movements which can even prevent a person from sleeping. Studies suggest that akathisia can result from decreased dopamine in the mesocortical dopamine system rather than in the striatum. It is noted further that the severity of restlessness is inversely correlated with prefrontal cortical dopamine, and that restlessness and attention respond well to dopamine agonists. All of this is closely related to a series of neuropsychological studies which we will review in Section 12.0.

6.2 Neurotransmitter Findings in ADD/ADHD Children.

There are a number of papers other than those listed in the previous section suggesting that ADD/ADHD is the result of a dopamine deficiency in the brain (Raskin et al., 1984; Shaywitz et al., 1976a, 1976b, 1977; Wender, 1974; Weizman et al., 1991). The evidence for a causal role for noradrenergic indicators and serotonin is inconclusive. Some studies indicate positive results for noradrenalin and serotonin and some negative results (see review by Weizman et al., 1991).

Zametkin and Rapoport (1987) reviewed studies dealing with the neurobiology of ADD/ADHD and concluded that no replicable results could be found that point to a consistent biochemical marker for the disorder. They noted that Urinary 3-methoxy-4-hydroxy-phenylglycol (MHPG, a major metabolite of norepinephrine) was decreased in four of six studies but felt that an inadequate washout period could account for this finding.

One earlier finding by Zametkin et al. (1984) has been recently replicated by Baker, Bornstein, Rouget, Ashton et al. (1991). Both groups found lowered urinary excretion of beta-phenylethylamine (PEA) in ADHD children. PEA is an endogenous amine similar to amphetamine in molecular structure and pharmacological properties. This finding is intuitively appealing since amphetamine preparations significantly ameliorate ADD/ADHD symptoms.

Dingott et al. (1992) found that ADD children have an altered hormonal response in a glucose challenge test. Children were studied for 5 hrs. after an oral glucose load. Basal, peak, and nadir plasma glucose levels were identical in ADD subjects and controls. However, the fall in glucose stimulated a brisk rise in plasma epinephrine and norepinephrine in controls but blunted responses of these agents in ADD children. Changes in plasma insulin, glucagon, and growth hormone were identical

in both groups. This suggests that ADD children have a more generalized impairment of sympathetic activation than previously thought, involving adrenomedullary as well as central catecholamine regulation.

A group of Norwegian investigators (Hole, Lingjaerde, Morkrid, Boler, Saelid, Diderrichsen, Ruud, and Reichelt, 1988) studied gel filtration patterns of peptides and protein-associated peptide complexes in the urine of 104 clinically referred children with ADD/ADHD. Compared with 36 controls, 64 of the clinic cases had increased benzoic acid-glycoprotein-peptide complexes in the late peaks of their gel filtration patterns. These 64 children all fit the criteria for diagnosis of ADD with hyperactivity. Thirty-five clinic children showed reduced amounts of uric acid complexes in the late peaks. With the exception of three subjects, these children fit criteria for the diagnosis of ADD without hyperactivity. Five patients showed reduced amounts of all urinary complexes, and four of them were hyperactive. Hole et al. do not speculate on how their findings might elucidate the pathophysiology of ADD with and without hyperactivity, but they do note finding unique gel filtration patterns in other psychiatric disorders.

Measurement of metabolites in the urine serve as an indirect measure of brain neurotransmitter activity, since brain neurotransmitter levels can not be directly measured. Shekim et al. (1979) reported changes in urinary metabolites of neurotransmitters that correlated positively with clinical improvement. The writers suggest that neurotransmitters as measured in urine may be a chemical marker for ADD/ADHD.

Several investigative teams have lumped children with ADHD, Oppositional Defiant Disorder, or Conduct Disorder into a Disruptive Behavior Disorders (DBD) category and looked for neurochemical correlates of behavior. Stoff, Friedman, Polluck et al. (1989) studied platelet monoamine oxidose activity (MAO) in 32 boys with DBDs and 47 boys with no DSM-III-R diagnoses. Boys with high MAO activity exhibited significantly poorer performance (i.e., more impulsivity) than those with low MAO levels on laboratory tasks requiring response inhibition (Matching Familiar Figures Test or MFFT, Gordon's tasks). High MAO patients were more impulsive than high MAO controls on some tasks, but elevated MAO levels were unrelated to personality questionnaire measures of impulsivity or to patient status. These researchers endorse the current theory that elevated MAO is a biological vulnerability trait, predisposing a person to psychiatric disorder, but not a pathognomonic marker for a specific disorder. They point out that MAO inhibitors have been used with success to treat hyperactive children (Zametkin et al., 1985), and they theorize that increased MAO activity may decrease intracellular concentrations of serotonin.

It should be noted that the findings of Stoff et al. are contrary to earlier findings by Shekim, Bylund, Alexson et al. (1986), who found lower platelet MAO levels in ADD/H boys and found low MAO to be associated with high impulsivity and inattention (MFFT and CPT measures).

Kruesi, Rapoport, Hamburger et al. (1990) measured cerebrospinal fluid levels of 5-hydroxyindoleacetic acid (CSF 5-HIAA), a metabolite of serotonin, in 29 children and adolescents with disruptive behavior disorders (DBDs), 21 of whom had an ADD diagnosis. The DSF 5-HIAA level was low compared with that of age-, sex-, and race-matched patients with obsessive-compulsive disorder. Within the DBD group, significant negative correlations with age-corrected CSF 5-HIAA level were found for the child's report of aggression toward people and the expressed emotionality of the child toward his/her mother, but CSF 5-HIAA levels were not related to impulsivity measures. Across the two patient groups, low 5-HIAA was associated with more psychosocial stress and less social competence.

These investigators suggest that reduced CSF 5-HIAA may be a biologic risk factor for subsequent aggressive behavior.

Another possible biological marker for aggressivity is lowered salivary cortisol level. Whereas Kagan et al. (1988) found elevated salivary cortisol in young children who showed extreme inhibition in social interaction with unfamiliar adults and undue distress upon separation from their mothers, McBurnett, Lahey, Freck et al. (1991) found in a sample of conduct disordered (CD) children that those without a comorbid anxiety disorder had lower salivary cortisol levels than those with comorbid anxiety. This finding takes on added meaning since CD boys with comorbid anxiety were found to have fewer police contacts, fewer school suspensions, and lower peer ratings of aggression than CD boys without anxiety disorders (Walker, Lahey, Russo et al., 1991).

Since ADHD children frequently have comorbid diagnoses of Oppositional or Conduct Disorder (Livingston, Dykman, and Ackerman, 1990), the above reports suggest that ADHD children with aggressive overlay should be studied on the more promising biological markers.

6.3 Neuroimaging Studies of ADD Subjects.

Computed tomography (CT) and Magnetic Resonance Imaging (MRI) are wonderful tools to look at the anatomy of the brain. Indeed, for a while it was believed that MRI would do away with any need for neuropsychology. PET Scans are the state-of-art tools for studying brain function. PET involves the injection of small amounts of harmless radioactive substances to measure either cerebral blood flow or glucose metabolism.

It has been found that as we learn something the area of cortex we use gets smaller and smaller (Massiotta, quoted by Mitiguy, 1992). In a word completion memory task, Squire (quoted by Mitiguy, 1992) found that the largest blood flow was in the right hippocampus and adjacent parahippocampal gyrus. Most interesting, subjects who performed well had less frontal activation than those who performed poorly; i.e., those with good memories didn't have to engage as many processing systems to search for an answer. Dr. Haier (quoted by Mitiguy) has shown that the brain uses less energy to perform a previously learned task. In brief, Dr. Haier found that glucose metabolism in the brain, as recorded by PET, decreased as scores in a computer game improved. The really exciting work of looking at cerebral function in various pathological states is just beginning. Unfortunately, the good ADHD studies, except for event related potentials (see below) are more in the static domain of looking for anatomical differences with CT or MRI than in studying changes in the brain at the time a person is engaged in some activity.

There is convincing evidence from cerebral blood flow studies, imaging studies, performance on neuropsychological and neurophysiological tests, and evoked response or event related potential and autonomic nervous system studies to suggest that biological factors are primarily responsible for ADD/ADHD/MBD (see reviews by Anastopoulos and Barkley, 1988; Barkley, 1990, book; Galaburda, 1985).

Galaburda et al. (1985) suggested that symmetry or reversed symmetry of the planum temporale may be a structural correlate of reading disability. Duncan et al. (1992) however, found the planum temporale in their imaging studies to be comparable in normal and dyslexic subjects.

Zametkin, Nordahl, Gross et al. (1990) used PET to study regional glucose metabolism in hyperactive adults with childhood onset of the disorder. Additionally each of these 25 adults was the biologic parent of a hyperactive child. The PET scans were done while subjects performed a computerized auditory attention task (press a button to the lowest tone). Global cerebral glucose metabolism was 8.1% lower in the hyperactive adults than in normal controls (N=50). This reduction in glucose metabolism was significant in 30 of 60 specific regions of the brain. Among the regions with greatest reductions were the premotor cortex and the superior prefrontal cortex - areas earlier shown to be involved in the control of attention and motor activity.

Hynd and associates (Hynd, Semrud-Clikeman, Lorys, Novey, & Eliopulos, 1990; Hynd, Semrud-Clikeman, Lorys, Novey, et al., 1991) have used magnetic resonance imaging (MRI) to study possible morphometric differences in ADD children. In the 1990 study, these investigators contrasted dyslexic, ADD/H, and normal children (10 in each group). They found that the dyslexic and ADD/H children had significantly smaller right anterior-width measurements than normal subjects. The dyslexics also had a bilaterally smaller insular region and left planum temporale than normals.

In their 1991 study, Hynd et al. studied the corpus callosum in 7 children with ADHD and 10 controls. While all MRI scans of the ADHD children were judged clinically normal, the ADHD subjects had a smaller corpus callosum than the normals, particularly in the region of the genu and splenium and in the area just anterior to the splenium. Interhemispheric fibers in these regions interconnect the left and right frontal, occipital, parietal, and posterior temporal regions.

Nasrallah, Loney, Olson, McCalley-Whitters et al. (1986) conducted a computerized tomographic brain scan study of 24 adult hyperactive males and 27 matched controls. They found the hyperactive subjects, all of whom had been followed since childhood, had a significantly greater frequency of cerebral atrophy.

Lou, Henriksen, Bruhn, Borner, and Nielsen (1989) employed regional cerebral blood flow/computed tomography technology to study ADD/ADHD children. They found hypoperfusion (implicating low metabolic activity) was most significant in the right striatum in children with ADHD only, but there was bilateral hypoperfusion in ADHD subjects with co-occurring neurological symptoms.

6.4 Recent EEG Studies of ADD Children.

Several research teams have investigated event related potentials (ERPs) in ADD subjects, and Courchesne and Yeung-Courchesne (1988) and Klorman (1991) have reviewed many of the studies. Most studies employ a variant of the so-called "odd-ball" paradigm, wherein subjects are required to attend to an infrequently occurring target stimulus and ignore a frequently occurring non-target stimulus. The most consistent finding across laboratories is an attenuated P3b component to target stimuli, which is theorized to reflect diminished deployment of attentional capacity. Satterfield, Schell, Nicholas, Satterfield, and Freese (1990) suggest that the attenuated P3b component in ADD groups may be due to insufficient noradrenergic activity. Klorman and associates (see Klorman, 1991) have shown that methylphenidate increases (normalizes) the amplitude of the P3b in ADD subjects.

Satterfield et al. (1990) and Loiselle, Stamm, Maitinsky, Whipple (1980) have reported, in addition to attenuated P3b components, abnormalities in earlier negative components of the ERP. These early components are theorized to reflect automatic processing deficits. However, a team of French investigators (Robaey, Breton, Dugas, & Renault, 1992) found hyperactive boys (aged 6-8 years) to have

larger early components than controls. Since they too found smaller late components (P350 and P500), they argued that ADD/ADHD children have enhanced automatic processes but inadequate higher-order controlled processes.

Smaller ERP components are not unique to ADHD children. Dykman and associates (Holcomb, Ackerman, and Dykman, 1985, 1986) have found equally attenuated P3b components in reading disability (RD), ADD/H and ADD/WO groups, both for auditory and visual stimuli. However, Harter's team (Harter, Anllo-Vento, Wood, and Schroeder, 1988; Harter, Diering, and Wood, 1988) reported separate ERP characteristics for RD and ADD. They used a metric called the difference potential, which entailed subtracting the waveforms of irrelevant from relevant stimuli. They found that selective neural processing, as defined by the difference potential, was actually greater in boys with ADD than those without ADD, whereas this metric was decreased in boys with RD as opposed to those who read adequately. These statistical differences depended on the combining of four subgroups to evaluate two grouping factors (RD or not, ADD or not). There were 25 normal readers (17 without ADD, 8 with ADD) and 27 RD children (11 without ADD and 16 with ADD). Therefore, the three clinical groups (ADD only, RD only, and both ADD and RD) were not directly compared with each other or with the normal control group (not ADD or RD). Thus, the reported findings are not clear-cut, and the difference potentials are not directly comparable to typically reported components (e.g., N1, N2, and P3b).

In addition to ERP studies, there have been a few investigations of EEG frequency (spectral) data. The focus here is usually on the amount of power in each of five bands. Increased activity in the slower bands (delta and theta) is usually theorized to index lowered arousal, whereas activity in the faster bands (low and high beta) is associated with mental processing; alpha activity is typically associated with the relaxed state (Andreassi, 1989). Callaway, Halliday, and Naylor (1983) found hyperactive subjects to have lower beta power than controls, as did Dykman, Holcomb, Oglesby, and Ackerman (1982), but Dykman et al. also found lowered beta power in RD subjects.

Recently, Ackerman, Dykman, and Oglesby (under review) have contrasted a group of normal reading ADD subjects with a group of poor readers. They studied both ERPs and spectral data in these subjects. The ADD group were considered a better control group for the poor readers than normally behaved children, because poor readers tend to exhibit attention problems even if not hyperactive. In fact the ADD and poor reader groups had virtually identical mean ratings on attention, hyperactivity, and aggression scales (parent and teacher).

The ERP data were collected in a rhyme detection task, and the components of interest were a late negative peak (N450), a subsequent positive peak (P500), and subsequent negative slow wave. These components separated rhyming from non-rhyming trials, and the normal reading ADD group from dyslexic poor readers (those underachieving by both age and IQ discrepancy criteria). Like normal reading adults (see Rugg, 1984), the ADD group had enhanced N450 peaks on non-rhyming as opposed to rhyming trials, but dyslexic poor readers had attenuated N450 peaks and augmented P500 peaks. The groups did not differ on the P3b component.

The EEG frequency data were collected as the children viewed strings of rhyming and non-rhyming first grade level words and letters. Their task was to recall the last word or letter in each string (40 seconds per condition), which was competently done, but the normal reading ADD group had significantly greater beta power than the poor readers. Also, when poor readers were divided into subgroups who differed in phonetic decoding skill, the dysphonetics had greater delta and theta power than "phonetics." Thus, by traditional interpretative standards (Andreassi, 1989), the poor readers less

actively processed the verbal stimuli, especially dysphonetic poor readers, who exhibited both diminished beta power and increased theta and delta power.

Dykman's group has also found ERP differences between ADD subjects with and without aggressive overlay. Newton, Dykman, Oglesby, and Ackerman (under review) studied three ADD subgroups (ADD/WO, ADD/H, and ADD/HA) and a normal control group in a warned reaction time task, conducted under non-contingent and contingent reward conditions. A late slow wave component of the ERPs to the warning stimulus (the word READY, flashed on a video screen) statistically separated the ADD/HA group from all other groups, but in the contingent reward condition only. This finding was interpreted to reflect the aggressive group's greater sensitivity to reward, which would be predicted by major theorists in the psychophysiology realm (Gray, 1975; Fowles, 1988; Quay, 1988).

Dykman's group has also investigated the phenomenon of ERP augmenting-reducing in ADD children. Zuckerman (1983) has been at the forefront in linking ERP augmentation to the trait of sensation seeking. ADD/H and ADD/HA children often exhibit behaviors that suggest they may be budding sensation seekers (see Dykman, Holcomb, Ackerman, and McCray, 1983). Dykman et al. found that children diagnosed as hyperactive had more augmenting auditory ERP gradients than non-hyperactive children (who were either ADD/WO or RD). Overall, the more intense the auditory stimuli (tones ranging from soft to very loud), the larger the N1-P2 component of the ERP. But, the gradient of the hyperactives was steeper than that for other children. Additionally, the results of a blinded clinical titration trial suggested that children with more augmenting gradients require lower doses of methylphenidate than less augmenting children.

Subsequently, Ackerman, Dykman, and Oglesby (1990) showed in a larger ADD sample that auditory ERP augmenters performed as well to a low as high dose of methylphenidate whereas reducers (or non-augmenters) responded better to a higher dose. The task used to show this difference was a 10 minute coding task that robustly separated ADD and control subjects (Dykman and Ackerman, 1991).

6.5 Recent Autonomic Nervous System Studies with ADD Children.

Earlier reviews of physiological correlates of ADD were provided by Hastings and Barkley (1978), Rosenthal and Allen (1978), and Zahn, Little, and Wender (1978). Dykman, Ackerman, Holcomb, and Boudreau (1983) followed with a review of physiological findings in learning disabled (LD) children, and many parallels were found. In general, both ADD and LD subjects tend to show less autonomic arousal than normal controls when engaged in active attention tasks. Baseline values and those obtained during passive attention tasks do not as consistently separate the clinical groups and controls.

Dykman, Ackerman, Oglesby, & Holcomb (1982) studied heart rate (HR) and skin conductance (SC) in four groups of boys: hyperactive (ADD/H) only, reading disabled only (RD), both ADD/H and RD (mixed), and controls. These measures were obtained in a visual search task wherein the child had to discover the target stimulus ("it") in order to gain reward. The target would pay off until the child made five consecutive correct responses. Then, a new stimulus became the target and the child again had to search for the new "it." The number of symbols in the visual field increased from 2 to 12. The child heard a penny dropping into a cup after each correct choice. Thus, silence served as negative feedback.

All groups showed a gradual increase in HR levels as the task became harder, and HR was higher following reward trials than search trials, but controls showed greater HR deceleration in anticipation of the subsequent trial than the clinical groups. Anticipatory HR deceleration has been consistently linked

to readiness to respond (Sroufe, Sonies, West, & Wright, 1973; Jennings, 1984), which leads to faster reaction times. Such was the case in this study. The skin conductance data did not separate the groups.

Dykman, Ackerman, and Oglesby (1992) recently studied HR reactivity in four groups of children: normal controls, ADD without hyperactivity (ADD/WO), ADD with hyperactivity (ADD/H), and ADD with hyperactivity and aggression (ADD/HA). A warned reaction time (RT) paradigm was employed in two conditions: baseline and contingent reward. The children were asked to attend to a visual warning (READY flashed on a TV monitor) that was followed after 5 seconds by the imperative stimulus. The imperative stimuli were 2 sec tones of three intensity levels (55 dB, 78 dB, 102 dB). The children were told to depress a RT key at the tone onset and release the key at tone offset, responding as fast as possible. After 5 practice trials they were told that if they continued to perform well, they would earn $1.00. Ninety trials ensued, 30 at each intensity level, in a predetermined randomized order. The intertrial interval varied randomly from 5 to 7 sec.

Following the baseline condition, the children were told they had earned $1.00 and that they would play the game again with the chance to earn more money. They were told to respond as fast as possible to each tone and that each fast response would earn 4 cents but that a slow response would result in 2 cents being taken away. Feedback was flashed after each trial ("you won 4 cents" or "you lost 2 cents," along with the cumulative total). Unknown to the child, the speed of the release responses determined the reward. This feature serves to discourage premature releases. A computer program updated the criterion for reward every 15 trials so that the child won 4 cents on roughly 80% of the trials and lost 2 cents on about 20% of the trials. Strong effects on RT were found for tone intensity and condition (baseline vs. reward); also, girls were slower than boys, and all ADD subgroups were slower than the normal control group.

Significant differences in HR reactivity were found between the controls and ADD subgroups, these modified by sex x group interactions. The ADD boys who were not hyperactive (ADD/WO) had lower tonic HR levels and greater phasic reactivity, a pattern similar to the control boys. The hyperactive (ADD/H) and hyperactive/aggressive (ADD/HA) boys had higher tonic HR levels but were less reactive to the stimuli. That is, the ADD/H and ADD/HA boys decelerated less in anticipation of the imperative stimulus and accelerated less to stimulus onset. Control girls had markedly higher HR levels than all other subgroups and were more reactive to the stimuli. The ADD/WO girls had low HR levels and, like the ADD/H and ADD/HA girls, were less reactive to the stimuli than control girls.

Dykman et al. suggested that the higher tonic levels of the ADD/H and ADD/HA boys could reflect their irritation with this rather boring task, whereas their less marked phasic reactivity to the warning and imperative stimuli could mirror (1) inattentiveness and (2) lack of involvement. This interpretation is compatible with the findings of Zahn, Kruesi, and Rapoport (1989), who reported higher HR levels in externalizing boys (hyperactive, aggressive, or both) than controls as the subjects participated in orienting and reaction time tasks. However, the Dykman et al. experiment featured reward and the Zahn et al. study did not. Thus, the Dykman et al. results can also be interpreted as supporting the Gray-Fowles-Quay model, which predicts greater HR increases to reward in antisocial than prosocial persons.

Delamater and Lahey (1983) reported skin conductance differences between hyperactive subjects with and without conduct problems. Those with conduct problems had lower SC levels. According to Fowles (1988), spontaneous skin conductance responses (SCRs) are more likely than SC levels to reflect the activation of the behavioral inhibitory system. Thus, his theory would predict that more disruptive

children would exhibit fewer spontaneous SCRs than controls or more anxious clinical subjects. Support for this position comes from a prospective study conducted by Raine, Venables, and Williams (1990), who studied 101 male students, aged 14-16, and then reviewed their court records at age 24. At follow-up, 17 of the group had criminal records. Compared with the non-criminal young men, the to-be offenders when initially studied had significantly lower resting HR levels and fewer SCRs. Earlier studies failed to show lower SCR counts in hyperactives and controls (Hastings & Barkley, 1978), but these studies did not subgroup the hyperactives on the aggression dimension.

6.6 Summary/Critique

This section is far from complete in terms of the number of papers that have been published in this area. The intent here is to convey some of the important studies that have been done in this area. One compelling conclusion emerges from these studies: ADD/ADHD is a biologically based disorder, whether the ultimate causes are genetic and/or environmental (e.g., early virus infections, lead poisoning, drug addictive mother). This conclusion is contrary to one presented by Rapoport and Ferguson (1981), who argued that biological measures are "behaviorally non-specific, of low sensitivity, and do not 'validate' a hyperkinetic syndrome" (p. 569). The problem with using biological measures to substantiate clinical behavior (e.g. hyperactivity as reported by parents or teachers) is that the reliability of the latter may not be any better than that of physiological measures. And because of this, the power of detecting differences is significantly affected by the unreliability of both ratings and physiological measures. This does not affect Type I errors but does affect Type II errors. Evidence has been presented in this section suggesting that ADD/ADHD children differ from normal age-matched controls in a variety of measures of brain functioning including neurotransmitters and in a number of autonomic measures assessing arousal and attention. However, it is not clear that these measures separate ADD/ADHD children with and without learning disabilities, which supports the behavioral literature showing that there is a considerable overlapping of characteristics (see next Section).

7.0 Experimental Approaches to ADHD.

From a selective review of the concordance of laboratory and clinical constructs, Barkley (1991) concludes that the ecological validity of most commonly used laboratory tasks in assessing ADHD is low to moderate. Ecological validity is defined in terms of existing clinical " theory." Thus, laboratory measures in this article are assessed in terms of their ability to assess inattention, impulsivity, and hyperactivity, the more or less agreed upon defining characteristics for ADD/ADHD (DSM-III-R of the American Psychiatric Association, 1987). It is truistic but necessary to say that ecological validity is increased by measures that directly assess any aspect(s) of the tripartite clinical definition of ADD/ADHD.

Mechanical measures of hyperactivity taken in a classroom correlate 0.50 to 0.60 with teacher ratings, which is, in fact, a little higher than the correlation between classroom behavior ratings by trained observers and teacher ratings (Buss et al., 1980). Commission errors on a reaction time task correlate moderately with parent ratings of hyperactivity at home (Weissberg et al., 1990). And it is well established that ADD/ADHD children have longer reaction times than normal children on a great variety of laboratory tasks (Ackerman et al., 1982; Douglas 1983; Dykman et al., 1985; 1992). Also, we know from a variety of studies that reaction time improves with stimulant medication (Ackerman et al., 1982) or immediate and/or continuous reward (see reviews by Douglas, 1983; Barkley 1977a; 1977b).

There have been a great number of studies using continuous performance tasks, and it is reported by some that these can be used to make a diagnosis of ADD/ADHD (Breen, 1989; Douglas, 1983; Gordon and Mettleman, 1988; Horn et al., 1989; O'Doughtery et al., 1984; Seidel and Joschko, 1990). Unfortunately for these measures, they are not very good as separating ADD/ADHD children from other clinical groups (Barkley et al., 1990; Dykman and Ackerman, 1985; 1991; Koriath et al.,1985). Barkley (1991) studied the correlations between Gordon's CPT, which is now being used widely in the assessment of ADHD or even to make the diagnosis, the Matching Familiar Figures Test (Kagan, 1966), behavioral observations of ADD/ADHD symptoms during a math task, and actometer measures of playroom activity. While there were many statistically significant correlations, the correlations were too low to assert that these measures have any reasonable ecological validity (correlations ranged from 0.12 to 0.36 in 6-11 year olds and from 0.12 to 0.44 in 12-20 year olds).

The correlations of the CPT measures with parent and teacher ratings of inattention and hyperactivity were also in the low to moderate range. But in one sense they were more promising; the commission score (false alarms) on the CPT correlated 0.41 with hyperactivity ratings and O.22 with inattention as assessed by the Conners Teacher Rating Scale. The corresponding correlations for hyperactivity and inattention on the Conners Parent Rating Scale were 0.22 and 0.34, respectively (all these correlations are statistically significant). Barkley (1990) concludes that the Gordon commission score has moderate ecological validity. But a comparable study of adolescents revealed a far weaker relationship; i.e., the omission score on the CPT did not correlate significantly with parent ratings of hyperactivity or teacher ratings of inattention.

Interestingly, studies that have used paper and pencil tests of continuous performance have, on average, correlated better with clinical ratings than the laboratory measures. Barkley (1990) attributes this to their greater length, stimulus complexity, and closer resemblance to classwork. The Matching Familiar Figures Test (MFFT), a presumed measure of impulsivity, did not correlate with the Gordon CPT, but omission scores on the Children's Checking Task (Margolis, 1972) correlate with MFFT scores (range 0.25 to 0.73) in literature cited by Barkley (Brown and Wynne, 1982; Keogh and Margolis, 1976). A significant problem with the MFFT is that relations of it to lab measures are appreciably weakened when age and IQ are partialled out (Milich and Kramer, 1984). Both error scores on the Gordon CPT correlate significantly with the distraction factor of the WISC-R (arithmetic, digit span, and coding) as reported by Brown and Wynne, (1982).

Barkley reviewed several measures of impulsivity in addition to the MFFT: errors of commission on CPT tasks, differential reinforcement of low response rates (Gordon, 1979), draw-a-line slowly (Campbell et al., 1982; Werry et al., 1987), cookie delay task (Campbell et al.,1982), and a delay of gratification task (Rapport et al., 1986). There are several problems with these studies: a need for replication by independent investigators other than developers of the methods; failure to separate ADHD children from other clinical groups; and failure to partial out age and IQ. One of these measures (impulsive responses on the delay of gratification procedure) correlates 0.74 with error scores on the MFFT and serves as an external validation of the ability of the MFFT to assess impulsivity.

Direct measures of activity do not correlate robustly with clinical ratings. They discriminate ADHD children from normals but fail to separate them from other clinical groups (Barkley et al., 1990; Barkley and Cunningham, 1979; Luk, 1985; Koriath et al., 1985).

Barkley (1991) concludes from his rather extensive review "that future advances in ecological validity are likely to come from: (a) a greater reliance on assessments of the target behaviors in natural

settings and (b) combining several of the more promising tasks and analogue methods into a battery that is taken over a longer time intervals than has been customary and averaged across repeated administrations" (p. 159). We seriously doubt that we will have to duplicate what teachers and parents see over a long period of time to derive a satisfactory laboratory battery. It is much easier and less costly to develop a diagnosis based on teacher and parent ratings than to bring children into the lab or to send a trained observer to the classroom and/or home, but this is not the way progress has been made in other medical fields. There is much promise both in psychophysiological and laboratory measures that will not only abet diagnosis but go beyond rating scales in discovering the underlying and basic defects of ADD/ADHD children.

A number of studies have questioned the notion that the central problem of hyperactive children is a defect in sustained attention (O'Dougerty, Neuchterlein and Drew, 1984; Prior et al., 1985; Schachar et al., 1988; Sykes et al., 1973; Van der Meere and Sergeant, 1988). Douglas (1988) used a large battery of tests designed to measure attention, and concluded that the basic information processing capabilities of ADHD children are intact. She attributed their defects to faulty self-regulation. Sergeant (1988) concluded that ADHD children do not have problems of either selective or sustained attention. His basic conclusion was much the same as that of Douglas; namely, that the problems of ADHD children are more in the area of modulationing attention or in the allocation of resources. Swanson et al. (1990), as previously mentioned, report that there is, in fact, a subgroup of ADD/ADHD children who do have attentional problems. This subgroup satisfied rigorous diagnostic criteria which excludes many children currently labeled as ADD/ADHD in research studies.

Van der Meere et al. (1991) used a self-paced paper and pencil test (PPCT) to study sustained attention in hyperactive children. This was a follow-up on earlier work of Sykes et al. (1973) showing that the sustained attention deficit of hyperactive children occurs in experimenter paced but not in self-paced tasks. Van der Meere and Sergeant argued that if a self-paced task is divided into blocks, attention would have to wane as a function of the number of blocks in order to support the hypothesis of a sustained attention deficit. More importantly, the slope for hyperactives over time would have to exhibit a significantly steeper descent than that of controls to say that hyperactive children have a sustained attention deficit. They found that while hyperactive subjects perform more poorly than controls over all time periods, the slopes for the two groups were the same. It was concluded, therefore, that the deficit was not in sustained attention.

The children in the Van der Meere and Sergeant study were divided into three groups: those rated hyperactive by parent or teacher ratings or laboratory ratings were termed mildly pervasive; those rated hyperactive in two of the settings just listed were termed moderately pervasive; and those rated as hyperactive in all three settings were termed extremely pervasive. The general supposition in the literature is that the severity of hyperactivity increases with the 'degree' of pervasiveness (Campbell et al., 1977; Schachar et al. 1981; Schleifer et al., 1975; Cohen and Minde, 1983; Sandberg et al., 1978). Pervasiveness is defined a bit differently in the rating scale literature; that is, a child is said to be 'pervasively' hyperactive if he/she receives extreme scores on both teacher and parent ratings. If the child is only hyperactive in one place, home or school, he/she is said to be 'situationally' hyperactive. In any event, Van der Meere and Sergeant found that the more pervasive the hyperactivity the slower and more variable the cancellation time.

Schneider and Shiffin (1977) and Shiffin and Schneider (1977) defined selective attention as a limitation in the rate of controlled processes, defined by encoding, search, and decision, occurring in short-term memory. Encoding rate is the time to process a difficult to perceive degraded ('vague')

stimulus in an easily recognizable form. Search rate refers to the time to process a given number of items (also referred to as load); e.g., the time it takes to find a single letter buried in a set of 10 other letters. Decision rate is the additional time required to choose a correct stimulus when an alternative stimulus (stimuli) is (are) added to the set.

According to Sternberg (1969), controlled search requires about 40-80 msecs for each item in the short term memory of normal children. Sergeant and Scholten (1983) found that the search time for hyperactive children was considerably longer and argue that this deficit is a problem in selective attention and not sustained attention. They say that sustained attention is assessed by time on task and that selective attention is assessed by load.

However, Sergeant and Scholten (1983) studied only 24 subjects: 8 who were both overactive and distractible; 8 who were only distractible; and 8 controls who were neither overactive or distractible. The children were given a task in which they were to recognize specific target letters (R,D, and N). All other letters were distractors. The children had to say whether target letters were present in sets of 2,3, and 4 letters. Encoding was manipulated by presenting stimuli in either intact or degraded forms. Children pressed a reaction time key with their preferred hand when a target was present and another key with the nonpreferred hand when the target was not present. A video camera recorded off task behaviors such as key playing.

No evidence was found to indicate that hyperactive children have a deficit in selective attention as assessed by the rate of encoding, search or decision. Hyperactives were, however, slower and less accurate than controls. They are really saying that there is something other than attentional processes per se that make hyperactive children different than controls. It is hypothesized that hyperactives and normals differ in the tradeoff between the instructions to respond rapidly (which accelerates errors) and instructions to respond accurately (which increases response time).

7.1 Recent Laboratory Studies of Attentional Systems.

As noted above, Posner and his colleagues (see Posner, 1992, for overview) have developed a visual-spatial paradigm that allows the evaluation of two neuroanatomically defined attention systems, one in the posterior and one in the anterior region of the brain. Swanson, Posner, Potkin et al. (1991) used the Posner paradigm to study ADD/ADHD children. They found the early posterior-based covert shift of attention to be normal, but a later, anterior-based overt shift of attention was abnormal as reflected by a significant lateral difference in reaction time. Swanson et al. believe this finding indicates a deficit in sustaining focused attention, and they attribute this to a disorder in the vigilance network of the right hemisphere. Posner (1992) points out that PET studies have shown increases in activation in areas of the right frontal lobe when subjects have to maintain attention for a long time. Also, patients with lesions of the right frontal lobe are not able to alert themselves following warning signals, whereas patients with lesions of the left frontal lobe are. Further, normal subjects who have to maintain attention for longer than 10 seconds show a strong asymmetry in reaction times, favoring targets going to the right hemisphere. It is hypothesized that right lateralization of norepinephrine underlies right hemisphere superiority during sustained visual attention (Whitehead, 1991).

Rothlind, Posner, and Schaughency (1991), spurred by the Swanson et al. study, compared ADHD children with normals in tasks that involve attentional control of eye movements. The children were instructed in one condition to ignore a fovea distractor and in another to shift their focus to a fovea stimulus (i.e., a pro- and anti- saccade task). This team found for the nonwarned condition that normal

children, like adults, were faster in moving their eyes in directions controlled by the right hemisphere. The ADHD children did not show this asymmetry.

In a simpler experiment, Voeller and Heilman (1988), using a letter cancellation task, found ADHD children exhibited laterally asymmetric inattention suggestive of right hemisphere dysfunction. The so-called hemi-neglect syndrome is, of course, a classic finding in patients with right parietal lobe lesions.

7.2 Recent Laboratory Studies of Impulsivity/Inhibitory Control.

Milich and Kramer (1984) provided a major review of studies dealing with impulsivity. They then designed a study employing six tasks and an impulsivity rating scale. Milich and Kramer point out the necessity of partialling out age and IQ effects on most tasks purporting to measure impulsivity, especially the widely used Matching Familiar Figures Test (Kagan, 1964), and the Porteus Maze Test. Of the tests employed by Milich and Kramer, the best was the Draw-A-Line Fast task, not, as predicted, the Draw-A-Line Slowly task. They conclude that in order to identify impulsive response styles, subjects should perhaps be encouraged to disinhibit rather than inhibit behavior. But, more recent studies have continued to focus on inhibition.

Halperin, O'Brien, Newcorn et al. (1990) have shown that a combined analysis of errors and latencies on the Continuous Performance Test can better distinguish impulsivity and inattention. They use the so-called "AX" version of the task, wherein the child is supposed to respond to an X only if it is preceded by an A. Omission errors and long latency X-only commission errors are considered valid measures of inattention. A-not-X errors with short latencies and A only errors with long latencies are considered measures of impulsivity. Other errors are called dyscontrol errors. Halperin et al. contrasted controls with three clinical groups on these measures. Relative to controls, the hyperactive only group had more errors of inattention, whereas the hyperactive/aggressive group had more impulsivity errors. The aggressive only group did not differ from controls. The groups were formed from scores on the Iowa Conners Teacher Questionnaire (Loney & Milich, 1982).

Schachar and Logan (1990) developed a stop-signal paradigm to study inhibitory control in children. They found that the ability to inhibit developed little after Grade 2, and that ADDH subjects showed deficient inhibitory control. Further analyses revealed that a subgroup of ADD subjects with pervasive hyperactivity (ADDH) had a more severe deficit than a situational hyperactive subgroup. The stop-signal paradigm purportedly distinguishes stimuli that elicit impulsive behavior (primary task stimuli) from those that inhibit it (stop-signals). The primary task is a forced choice letter discrimination procedure and the stop-signal is a tone. Stop-signals are presented at various delay intervals before the letters appear. If the stop stimulus occurs early enough, the subjects can inhibit every time, and if it occurs too close to stimulus onset, no one can inhibit. The experimenters are interested in the probability of inhibition at various delay intervals.

Trommer, Hoeppner, Lorber, and Armstrong (1988) used what they term a "go-no-go" test to study impulsivity. The test is sensitive to frontal lobe lesions in animals and humans. The stimuli are presented via audio tape, and the subject is instructed to raise his/her index finger in response to the go signal (a single tap sound) but to refrain raising the finger to the no go signal (two taps). In a contrast of ADD/WO, ADD/H, and control subjects, the two ADD groups made significantly more errors than controls. There were two blocks of trials (10 stimuli each), and, unlike the ADD/WO and control children, the ADD/H children made no improvement in performance on Block 2.

Mitchell, Chavez, Baker, Guzman, and Azen (1990) have employed a video choice reaction time (RT) task to study sustained attention and impulsivity in hyperactive children. Interestingly, they found the hyperactive children to show relatively greater impairment than controls when required to respond with the non dominant hand. Complex RT (press to a red box with the right hand and a blue star with the left, but don't press to either a blue box or red star) provided more sensitive discrimination of hyperactives than error scores; they were slower and more variable than controls. But the task is not that promising as a clinical tool, for only 60% of hyperactives were correctly identified by a composite score.

7.3 Studies of Stimulus Seeking Behavior in Hyperactive Children.

Zentall and Zentall (1983) proposed that hyperactive children are less tolerant of lower levels of arousal than non-hyperactive children and that they should derive greater gains from stimulation added to repetitive tasks than comparison children. To test this "optimal stimulation theory," Zentall, Falkenberg, and Smith (1985) compared attention problem adolescents with controls in two conditions of a copying task. Low-stimulation booklets were black letters on white paper. High-stimulation booklets had colored letters. The error rate for the ADD group was significantly lower for color stimulation than black on white, whereas controls had equivalent performance for the two conditions.

Zentall and Meyer (1987) next hypothesized that motor responses added into rote tasks would modulate the sensation-seeking activity of hyperactive children. ADD/H children and controls were administered two repetitive tasks (word decoding and auditory vigilance) under both an active response and a passive response condition. In the high stimulation (active response) condition, impulsive errors, talking/noise-making, and activity of the ADD/H children did not differ from the control children. Behavioral improvements for ADD/H children were found in both tasks under the active condition, but performance gains were found only in the vigilance task.

Zentall (1986) also found that non-relevant colored and patterned stimuli added to the letters of a visual Continuous Performance Task normalized the performance of hyperactive children and reduced their excessive activity.

In another test of the optimal stimulation theory, Zentall (1988) compared the verbal output of hyperactive and normal children under nonelicited and elicited conditions. In support of her hypothesis, she found the hyperactive children were more spontaneously talkative during transitions and nonverbal tasks but were less talkative when asked to tell stories. This finding no doubt is related to overtalkative behavioral ratings of hyperactive children. Minimally stimulating conditions precipitate excessive verbal activity (talking, making noises with mouth).

7.4 Summary/Critique

There is evidence from some studies, not all, to suggest that the central problem of ADD/ADHD children may not be that of sustained or selective attention; i.e, these children do pay close attention in certain situations. Perhaps their fluctuations of attention are more related to their lack of tolerance of boredom than anything else. In our experience, the laboratory tasks which best separate hyperactive or LD children from normals are those that seem to us to be most boring. It would seem to us that some of the disagreement about inattention, yes or no in ADD/ADHD children, is a matter of semantics: at least to us the boundary lines between inattention/attention, working memory, arousal, executive function, effort are somewhat obscure. We believe, that at least for now, the term Attention Deficit Disorder is as good as any other and really captures one of the main things that teachers complain about. The

experimental studies that have been done are very interesting and this work should continue, but with more attention to comparing ADD/ADHD children with other clinical groups than with normal controls. A very important issue is whether we can develop laboratory tests which will differentiate ADD/ADHD children with a reading disorder (RD) from those with ADD/ADHD or RD alone.

8.0 Conditions Comorbid with ADD/ADHD.

In previous sections, we have mentioned the overlap of ADHD with learning disabilities, and it appears that some of the same biological factors that produce ADHD may also affect reading and spelling. ADD/ADHD has been found to co-occur with virtually every childhood/youth disorder including mental retardation, substance abuse, and Tourette's syndrome, and conduct, oppositional, mood, anxiety, borderline personality, and learning disorders (Ackerman and Dykman, 1990; Andrulonis, 1991; Baker and Cantwell, 1983; Barkley et al., 1991; Biederman, 1991; Biederman et al., 1991; Borden et al., 1987; Cantwell, 1991; DeMillo, 1989; Daugherty et al., 1991; Greenfield et al., 1988; Hechtman and Weiss, 1986; Hechtman et al., 1984; Jensen et al., 1988; Kramer and Loney, 1982; Kutcher et al., 1989; Lahey et al., 1988; Levy et al., 1987; Livingston et al., 1992; Livingston et al., 1990; Loeber and Lahey, 1989; Mannuzza et al., 1991; Nieves, 1991; Offord et al., 1989; Pliska, 1992; Quay, 1988; Rounsaville et al., 1991; Taylor, 1988; Taylor et al., 1986; Wood et al., 1983). Because all these conditions tend to be familial, it is possible that subtypes can be defined on the basis of patterns of comorbidity.

Shaywitz and Shaywitz (1991) examined the comorbidity of ADD with learning disabilities (LD) and Conduct and Oppositional Disorders (COD). This article supports the independence of ADHD from these other disorders while admitting to a significant overlap. Shaywitz and Shaywitz emphasize that unreliability of diagnoses and variation of criteria both within and outside the U.S. greatly affects differences in prevalence rates. Another problem noted by Shaywitz and Shaywitz is that of subtypes of ADD. They say:

> "That good evidence supports this differentiation between subtypes of attention disorder, demonstrating that while ADDH [ADD plus Hyperactive) and ADDnoH [ADD and not Hyperactive] do not differ on independent measures of attention (King and Young, 1982; Edelbrock et al., 1984; Lahey et al., 1987; Lahey and Carlson, In Press) ADDH and ADDnoH children demonstrate significantly different behavioral, academic, and social patterns (Edelbrock et al.,1984). Of particular interest, Lahey et al. (1987) indicate that ADDnoH boys are rated by their teachers as manifesting a poorer school performance compared to ADDH boys, a finding supported by the high rate of retention (71.5%), high even in relation to ADDH boys (16.7%)..." (p. 16).

The Shaywitzes estimate, on the basis of their studies, the overlap of ADD/ADHD and LD to range from 9-10% in hyperactive boys (Halperin et al., 1984) and 11% in an epidemiologic sample of eight-year old Connecticut school children (Shaywitz, 1986). In our clinic referred populations, we find that some one-third to one-half of all ADD/ADHD children are LD, depending on the criteria one uses to label a child as LD (Ackerman and Dykman,1990; Dykman and Ackerman, 1991). The Shaywitzes say that in LD populations, the reported prevalence of hyperactivity has varied from 48% (Holborow and Berry, 1986) to 80% (Safer and Allen, 1976). It is well known that ADD/ADHD children are more apt to experience academic difficulties than normal children (Cantwell, 1978; Holborow and Berry, 1986).

Biederman et al. (1991) reviewed the literature on the comorbidity of ADHD with Conduct, Depressive, Anxiety, Mental Retardation, Tourette's Syndrome, and Borderline Personality Disorder, and

they report that all of these disorders overlap ADHD. It is concluded that ADHD might be delineated on the basis of the disorder's comorbidity with other disorders. It is stated that:

> "These subgroups may have differing risk factors, clinical courses, and pharmacological responses. Investigation of these issues should help to clarify the etiology, course, and outcome of attention deficit hyperactivity disorder" (p.564).

The Biederman article states that ADHD and Conduct Disorder have been found to occur together in 30 to 50% of the cases in both epidemiological and clinical samples, which has led some persons to believe that they are a common disorder. Biederman et al. from a review of some 30 articles conclude that ADHD and Conduct Disorder are at least partially independent.

The overlap with Oppositional-Defiant Disorder (ODD) is at least as great and perhaps even greater, judging by the articles reviewed by Biederman et al. However, there were only a few articles pertaining specifically to ODD and ADHD. Biederman et al. suggest that in terms of severity of the clinical picture, children with ADHD and ODD are intermediate between those with ADHD alone and those with ADHD and Conduct Disorder.

Perhaps because depression in children is difficult to diagnose objectively, the estimates of comorbidity of depression and ADHD are excessively variable, and range from 15-75% in different studies. Elsewhere, Biederman et al. (1989) have reported findings that support the hypothesis that ADHD and major depressive disorder share common familial vulnerabilities. This earlier study found that the two disorders did not cosegregate within families, and the risk of major depressive disorder in the relatives of children with ADHD was much higher than the risk in the relatives of normal children.

As reported by Biederman et al., there are many articles to suggest that the comorbidity of ADHD and other disorders is also substantial: 10-90% for learning disorders; about 25% for Anxiety Disorders; about 60% in Tourette's Syndrome; and about 25 % for Borderline Personality Disorder. And ADHD occurs 3-4 times more frequently in mentally retarded children than normals, particularly in the so-called educable group.

In a very good study, Epstein et al. (1986) asked teachers of handicapped and nonhandicapped school children (ages 6-18) to rate hyperactivity using the Conners Abbreviated Teacher Rating Scale (ATRS). They obtained ratings on the following groups: behavior disordered (BD, N= 231, 42 females), educable mentally retarded (EMR, N= 225, 108 females), and learning disabled (LD, N= 933, 299 females) children and youth including nonhandicapped controls (NH, N=480, 212 females) in regular classrooms. All subjects were attending public schools in the Northern Illinois area. Except for the EMR group, the majority of handicapped children were spending over 50% of their time in regular classrooms.

The prevalence of hyperactivity was 21.7% in younger (ages 6 to 11) LD males and 8.9% in younger LD females. The corresponding percentages for older children/youth (ages 12 to 18) were 23.7 and 12.0, respectively. The percentages for EMR children were similar to those for the LD group. The BD groups, as might be expected, had the highest percentages of hyperactivity: 51.5% for younger males, 36.4% for younger females, 38.1% for older males, and 38.7% for older females. As for gender, the only significant differences were in the LD category: females lower than males in both younger and older groups ($p < .01$ in both cases). The NH results were presented in the epidemiological section. The surprising finding for NH is that hyperactivity actually increased with age (just the opposite of what

has often been reported in the literature). The percentage for younger males was 4.4 as contrasted with 8.2 for older males; and the percentage for younger females was 3.5 as contrasted with 5.0 for older females. The classification of prevalence was based upon a cut score of greater than or equal to 15 (two standard deviations above the mean) as was suggested by Sleator and von Neumann (1974). The authors discuss some of the major findings of their study as follows:

> "Perhaps the most unexpected finding from the present investigation is that the percentage of elementary school-aged LD and EMR boys who were rated as behaviorally equivalent to clinic samples is very similar to the rate for boys in the general school population in Italy (Barling, O'Leary, & Taffinder, 1983), Spain (Arias & O'Leary, 1984), New Zealand (Werry & Hawthorne, 1976), and the United States (Ullman, Sleator, & Sprague, 1985). However, for younger females, only the rate for LD girls was comparable to that reported for other studies. The percentage of girls above the cutoff in EMR and BD classes is two and three times higher, respectively. There does not appear to be any marked change in the rate between younger (elementary school) and older (junior and senior high school) students in any of the special educational groupings"(pages 225-26).

Pelham et al. (1992) published an article on teacher ratings of DSM III-R symptoms for the disruptive behavior disorders (N=931 boys in regular classrooms and in grades from K through 8). Of the 931 boys, 853 had no diagnosis. Of the remaining 78, 33 were ADHD, 15 were oppositional- defiant, 17 were both ADHD and oppositional-defiant, 2 were oppositional-defiant and conduct disorder, 1 was ADHD and conduct disorder, and 10 were ADHD plus oppositional-defiant plus conduct disorder. There were no children who were only conduct disorder. These figures are not typical of children referred to clinics for school problems.

8.1 Summary/Critique.

The bulk of the literature supports the idea that ADD/ADHD is independent of other disorders although the symptoms of ADD/ADHD are often found in other disorders. Hence, for research purposes it would be well to segregate children on the basis of whether they have ADD/ADHD alone or in combination with other disorders. Most studies of ADD/ADHD children do exclude those with very low IQs and Pervasive Developmental Disorders. In general, the evidence we have reviewed in this section supports the following conclusions:

1) Externalizing psychiatric conditions are more likely to occur in hyperactive ADD subjects than in nonhyperactive ADD subjects (Barkley et al., 1990; Livingston et al., 1990).

2) Internalizing psychiatric conditions are more likely to occur in nonhyperactive ADD subjects than in hyperactive ADD subjects (Barkley, 1990; Livingston et al., 1990).

3) Subjects with severe ADHD tend to be younger at referral, to have lower IQs than subjects who have only conduct or anxiety disorders (Levy et al., 1987).

4) Many of the differences reported between ADHD subjects with different co-occurring psychopathologies would disappear if there were an adequate control of both age and IQ (Werry et al., 1987).

5) While conduct disorder is frequently comorbid with ADHD, the diagnosis of conduct disorder is not any more reliable than that of ADD (Taylor, 1988, Rutter and Garmezy, 1983).

6) While conduct disorder occurs quite frequently with ADHD, it is a separate disorder from ADHD (Biederman et al., 1991; Taylor, 1988).

7) While anxiety disorders coexist with ADHD, it is probably wrong to think of ADD/ADHD as secondary to or caused by anxiety or depression (Barkley, 1990).

9.0 Rating Scales.

We have been able to identify 42 rating scales that have been used to describe or diagnose ADD/ADHD/Hyperactivity. All of these provide norms of one kind or another and all cite measures of reliability and validity (see Table 1). It is obvious that a significant number of investigators have turned to rating scales not only for profit motives but as the road to success in this field. Barkley's (1990) book contains an excellent section on assessment, including a chapter describing in detail many of the rating scales. **There is no substitute, however, for reviewing the normative data in the test and administration manuals published by the developers of these scales.**

Table 1. Attention Deficit Disorder Rating Scales

Test Name and Developer	Normative Data Available	Domains Assessed
Academic Performance Rating Scale (DuPaul, George J.; Rapport, Mark D.; Perriello, Lucy M., 1991)	n=247 (grades 1-6)	Learning Ability, Academic Performance, Impulse Control, Social Withdrawal
ADD-H Comprehensive Teacher Rating Scale (Ullmann, R. K.; Sleator, E. K.; Sprague, R. L., 1984)	n=1347 (5-12 years)	Oppositional Behavior, Attention, Hyperactivity, Social Problems
ADHD Rating Scale (DuPaul, G. J., 1990)	n=765 for parents, n=551 for teachers (6-12 years)	Inattention-Restlessness, Impulsivity-Hyperactivity
Behavior and Temperament Survey-Home Version (Lambert, N. M.; Hartsough, C.S., 1987)	n=210 (6-11 years)	Hyperactivity, Inattention, Conduct Disorder, Impulsivity
Attention Deficit Disorders Evaluation Scale - Home Version (McCarney, Stephen B., 1989)	n=1754 (4-20 years)	Inattention, Impulsivity, Hyperactivity
Attention Deficit Disorders Evaluation Scale - Teacher Version (McCarney, Stephen B., 1989)	n=4876 (4-20 years)	Inattention, Impulsivity, Hyperactivity

Test Name and Developer	Normative Data Available	Domains Assessed
Behavior Assessment System for Children- Parent Rating Scales (Reynolds, Cecil R.; Kamphaus, Randy W., 1992)	n's= 333, 1259, 809 (4-5, 6-11, 12-18 years)	Adaptability, Aggression, Anxiety, Attention Problems, Atypicality, Conduct Problems, Depression, Hyperactivity, Leadership, Learning Problems, Social Skills, Somatization, Study Skills, Withdrawal
Behavior Assessment System for Children- Teacher Rating Scales (Reynolds, Cecil R.; Kamphaus, Randy W., 1992)	n's= 309, 2084, 1090 (4-5, 6-11, 12-18 years)	Adaptability, Aggression, Anxiety, Attention Problems, Atypicality, Conduct Problems, Depression, Hyperactivity, Leadership, Learning Problems, Social Skills, Somatization, Study Skills, Withdrawal
Behavior Assessment System for Children- Self-Report of Personality (Reynolds, Cecil R.; Kamphaus, Randy W., 1992)	n's= 5413, 4448 (6-11, 12-18 years)	Anxiety, Attitude to School, Attitude to Teachers, Atypicality, Depression, Interpersonal Relations, Locus of Control, Relations with Parents, Self-Esteem, Self-Reliance, Sensation Seeking, Sense of Inadequacy, Social Stress, Somatization
Original Behavior Problem Checklist (Quay, H. C.; Peterson, D. R., 1975)	(5-13 years)	Conduct Problems, Personality Problems, Inadequate-Immature, Socialized Delinquency
Revised Behavior Problem Checklist (Quay, H. C.; Peterson, D. R., 1983)	(5-17 years; for teachers and mothers)	Conduct Disorder, Socialized Aggression, Attention Problems-Immaturity, Anxiety-Withdrawal, Psychotic Behavior, Motor Tension Excess
Child Attention Problems by Craig S. Edelbrock, Ph.D. (Barkley, Russell A., 1988)	n=1100 (6-16 years)	Inattention, Overactivity
Child Behavior Checklist/2-3 (Achenbach, T. M., 1991)	n=368 (2-3 years)	Withdrawn, Anxious/Depressed, Sleep Problems, Somatic Problems, Aggressive Behavior, Destructive Behavior, Internalizing, Externalizing
Child Behavior Checklist/4-11 (Achenbach, T. M., 1991)	n=2368 (4-18 years)	Social Activities, School Activities, Withdrawn, Anxious/Depressed, Somatic Problems, Social Problems, Thought Problems, Attention Problems, Delinquent Behavior, Aggressive Behavior, Internalizing, Externalizing

Test Name and Developer	Normative Data Available	Domains Assessed
Teacher's Report Form (Achenbach, T. M., 1991)	n=1391 (5-18 years)	Academic Performance, Working Hard, Behaving Appropriately, Learning, Happy, Withdrawn, Anxious/Depressed, Somatic Problems, Social Problems, Thought Problems, Attention Problems, Delinquent Behavior, Aggressive Behavior, Internalizing, Externalizing
Youth Self-Report (Achenbach, T. M., 1991)	n=1315 (11-18 years)	Social, Activities, Withdrawn, Anxious/Depressed, Somatic Problems, Social Problems, Thought Problems, Attention Problems, Delinquent Behavior, Aggressive Behavior, Internalizing, Externalizing
Children's Behavior Questionnaire (Rutter, Michael, 1967)	n=479 (7-13 years)	Aggressive-Antisocial, Anxious-Fearful, Hyperactivity
Conners Parent Rating Scale-revised (PQ-48) by C. Keith Conners, Ph.D. (Goyette, C. H.; Conners, C. K.; Ulrich, R. F., 1978)	n=570 (3-17 years)	Conduct Problems, Learning Problems, Psychosomatic, Impulsive-Hyperactive, Anxiety
Original Conners Parent Rating Scale (PQ-93) (Conners, C. K., 1970)	n=683 (6-14 years)	Conduct Disorder, Fearful-Anxious, Restless-Disorganized, Learning Problem-Immature, Psychosomatic, Obsessional, Antisocial, Hyperactive-Immature
Conners Teacher Rating Scale-revised (TQ-28) by C. Keith Conners, Ph.D. (Goyette, C. H.; Conners, C. K.; Ulrich, R. F., 1978)	n=383 (3-17 years)	Conduct Problems, Hyperactive, Inattentive-Passive
Original Conners Teacher Rating Scale (TQ-39) (Conners, C. K., 1969)	n=103 (4-12 years)	Hyperactivity, Conduct Problem, Emotional-Overindulgent, Anxious-Passive, Asocial, Daydreams/ Attendance Problem
Conners Abbreviated Symptom Questionnaire- Parent version by C. Keith Conners, Ph.D. (Goyette, C. H.; Conners, C. K.; Ulrich, R. F., 1978)	n=570 (3-17 years)	Not Factor-analyzed
Conners Abbreviated Symptom Questionnaire- Teacher version by C. Keith Conners, Ph.D. (Goyette, C. H.; Conners, C. K.; Ulrich, R. F., 1978)	n=383 (3-17 years)	Hyperactivity, Conduct Problems

Test Name and Developer	Normative Data Available	Domains Assessed
Iowa Conners Teacher Rating Scale (Loney, J.; Milich, R., 1982)	n=608 (grades 1-5)	Inattention/Overactivity, Aggression
Cooper-Farran Behavioral Rating Scales (Cooper, David H.; Farran, Dale C., 1993)	n=1458 (Kindergartners)	Interpersonal Skills: Aggressive, annoying, or disruptive behavior Work-related Skills: Organization, Independence, Remembering and Following Directions, Persistence in Task Completion
Devereux Elementary School Behavior Rating Scale (Spivack, G.; Swift, M. S., 1967)	n= 579 (grades K-6)	Classroom Disturbance, Impatience, Disrespect-Defiance, External Blame, Achievement, Anxiety, External Reliance, Comprehension, Inattentive-Withdrawn, Irrelevant Responsiveness, Creative Initiative, Need for Closeness to Teacher
Disruptive Behavior Disorders (Pelham, W.E.; Gnagy, E.M.; Greenslade, K.E.; Milich, R., 1992)	n's= 154, 369, 279 and 129 (5-6, 7-8, 9-10, 11-14 years)	Oppositional/Defiant, Inattention, Impulsivity/Overactivity
Eyberg Child Behavior Inventory (Eyberg, S.M., 1980)	n's=512 and 102 (2-7 and 13-16 years)	Conduct Problems/Oppositional Behavior
Home Situations Questionnaire (Barkley, R. A., 1987)	n=1060 (4-16 years)	Social Interaction, Oppositional-Unfocused, Oppositional-Focused, Self-engaged Situations
Home Situations Questionnaire-revised (DuPaul, G. J., 1990)	n=581 (6-12 years)	Self-Care/Public Settings, Chore/Social Settings
School Situations Questionnaire (Barkley, R. A., 1987)	n=615 (4-11 years)	Social Interaction, Focused Attention, Novel Activities Situations.
School Situations Questionnaire-revised (DuPaul, G. J., 1990)	n=490 (6-12 years)	Not yet determined
Groningen Behavior Observation Scale (1991) by W. Vaessen and J.J. Van der Meere	n=436 for teachers, n= 220 for parents	Activity, Attention, Impulsivity, Rapidly Changing Task Orientation, Talkativeness
Illinois Classroom Assessment Profile (Porges, Stephen W.; et al, 1985)	n=707 (grades 2-3)	Conduct Disorder, Ability to Concentrate, Coordination, Evaluation Anxiety, Impulsivity

Test Name and Developer	Normative Data Available	Domains Assessed
Louisville Behavior Checklist-E1 (Miller, L.C, 1984)	n=289 (4-6 years)	Infantile Aggression, Hyperactivity, Antisocial Behavior, Social Withdrawal, Sensitivity, Fear, Intellectual Deficit, Immaturity, Aggression, Inhibition, Cognitive Disability
Louisville Behavior Checklist-E2 (Miller, L.C, 1984)	n=236 (7-13 years)	Infantile Aggression, Hyperactivity, Antisocial Behavior, Social Withdrawal, Sensitivity, Fear, Academic Disability, Immaturity, Aggression, Inhibition, Learning Disability
Multi-grade Inventory for Teachers (Agronin, Marc E.; Holahan, John M.; Shaywitz, Bennett A.; Shaywitz, Sally E., 1992)	n=445 (grades K-5)	Academics, Language, Dexterity, Attention, Activity, Behavior
Personality Inventory for Children (Lachar, D., 1982)	n=2390 (6-12 years)	Undisciplined/Poor Self-Control, Social Incompetence, Internalization/Somatic Symptoms, Cognitive Development
Preschool Behavior Questionnaire (Behar, L.; Stringfield, S., 1974)	n=496 (3-6 years, teacher ratings)	Hostile-Aggressive, Anxious, Hyperactive-Distractible
School Social Behavior Scales (Merrell, Kenneth W., 1993)	n=1858 (grades K-12)	Social Competence: Interpersonal Skills, Self-Management Skills, Academic Skills; Antisocial Behavior: Hostile-Irritable, Antisocial-Aggressive, Disruptive-Demanding
Self-Control Rating Scale (Kendall, P. C.; Wilcox, L.E., 1979)	n=110 (8-11 years, teacher ratings)	Self-Control Behavior
Swanson, Nolan, and Pelham Rating Scale (SNAP) (Swanson, J.M.; Pelham, W., 1988)	n=986 (6-11 years)	Inattention, Hyperactivity, Impulsivity, Peer Problems
CLAM (Swanson, J.M. 1992)	Sample size not stated (6-7, 8-9, 10-11)	Inattention, Overactivity, Aggression, Defiance.
SCLAM (Swanson, J.M., 1992)	Sample size not stated (6-11)	Inattention, Overactivity, Aggression, Defiance, Peer Interaction

Test Name and Developer	Normative Data Available	Domains Assessed
Yale Children's Inventory (Shaywitz, Sally E.; et al, 1986)	n=260 (8-14 years)	Attention, Habituation, Hyperactivity, Tractability, Impulsivity, Negative Affect, Conduct disorder-socialized, Conduct disorder-aggressive, Academic, Fine motor ability, Language
Werry-Weiss-Peters Activity Rating Scale (Werry, J.S.; Sprague, R.L., 1970)	n=140 (1-9 years)	Television, Bedtime/Sleep, Mealtime, Play Behaviors, Restlessness

Ideally, a rating form should be as brief as possible if one is desirous of obtaining the cooperation of teachers. However, reliability is dependent, in part, on the number of items in a scale, and one must be a bit suspicious of scales which claim substantial reliability with only 4-5 items assessing impulsivity or hyperactivity.

Barkley (1990) outlines some of the important properties of rating scales as follows:

"1. The scale should have items that are worded so as to make it clear to the respondent what is being rated...

2. The scale should have enough items pertaining to the psychological or behavioral construct(s) to be an adequate sampling of the domain of this construct and to be reliable as a measure of it...

3. The answer format provided for the items should have a sufficient range to allow for a representative sampling of the range of frequency for the symptom or construct within the population of interest. Simple 'yes-no' formats rarely permit this finer discrimination of frequency or severity that may be necessary to discriminate clinical from normal populations...

4. The item should have some 'face validity'; that is, its content should reflect the construct(s) of interest...

5. The scale should demonstrate validity in assessing the construct of interest. That is, it should correlate significantly with other measures of the same construct(s) taken by other means or from other sources. Related to this concept is the notion of 'concurrent validity' or 'ecological validity.' The scale must be significantly related to measures of the behaviors or constructs of interest taken in the natural setting in which the problem is known to exist. It is not surprising to find that even the best rating scales of ADHD correlate only moderately (.30 to .50) with actual observations of ADHD symptoms taken in home or classroom settings (Barkley, 1989c).

6. Another psychometric requirement of rating scales related to construct validity is "discriminant validity." In other words, does the scale discriminate between samples of subjects that are known to have more or less of this particular behavior or symptom?...

7. It is quite helpful clinically if the scale can demonstrate some 'predictive validity' in that it correlates significantly with the same scale or other comparable measures taken at some later time in development...childhood ratings of aggression or conduct problems of ADHD children are

significantly related to adolescent ratings of parent-child conflicts as well as delinquency as much as 8 years after the initial assessment (Barkley et al., 1990).

8. Rating scales should also have acceptable levels of reliability both over time and between raters...

9. Finally, it would be very beneficial to clinical practice for scales to demonstrate some 'prescriptive utility.' This refers to the ability of a scale to predict a person's differential response to subsequent treatments...several recent studies suggest that unusually high ratings on rating scales assessing anxiety and depression are predictive of adverse responses to stimulant medication (Voelker et al., 1983; Taylor 1986b), while high ratings on scales assessing inattention predict a positive response to these medications..." (pp. 281-282).

Barkley states unequivocally that rating scales offer numerous advantages over other methods of assessment. Among the advantages mentioned, the following are particularly important; rating scales allow one to obtain information from raters who have had many years of experience with ADHD children; permit the collection of data on infrequently occurring behaviors that are likely to be missed by in vivo measures; and are cost effective and require little time to complete. The best rating scales provide extensive normative data that enable the user to score the statistical deviance of the ratings; i.e, score in standard deviation units or percentiles reflecting a subject's relative position in the age and sex group which was used to compile the test norms (normative sample).

Of the rating scales listed in Table 1, Barkley recommends that the following would be most useful in a general clinical assessment of ADHD children ages 2-11.

Achenbach Child Behavior Checklist (parent and teacher forms)
ADHD Rating Scale (DuPaul)
DuPaul Home Situations Questionnaire-Revised
DuPaul School Situations Questionnaire-Revised
DuPaul Academic Performance Scale

For adolescents, Barkley recommends the Child Behavior Checklist (both parent and teacher scales) and the ADHD Rating Scale as above, but replaces the last three on the above list with the following:

Achenbach Child Behavior Checklist--Youth Self Report
Conflict Behavior Questionnaire (Robins and Foster, 1989)
Robin & Foster Issues Checklist (Robins and Foster, 1989)

Barkley notes that the following scales have been used in his clinic to assess drug effects: Conners Parent Rating Scale-Revised, Conners Teacher Rating Scale-Revised, Home Situations Questionnaire-Revised, School Situations Questionnaire-Revised, Academic Performance Scale, and, very important, Barkley's Stimulant Drug Side Effects Rating Scale (p. 599 in Barkley's 1990 book).

In this very thorough and detailed book, Barkley also lists scales that can be used to evaluate the effects of parent training. These are pretty much the same as those listed above for assessment, with one exception, the Parenting Practices Scale (for ADHD children) developed by Strayhorn and Weidman (1988). Parents themselves may be assessed with the following: Derogatis (1986) Symptom Checklist

90-Revised (a brief rating scale of various psychiatric symptoms), Locke-Wallace (1959) Marital Adjustment Test (brief scale of marital satisfaction), Parenting Practices Scale, Conflict Behavior Questionnaire for parents of ADHD teens, and the Issues Checklist for Parents of ADHD teens.

Barkley appropriately notes that considerable diplomacy must be used in asking parents to allow themselves to be evaluated along with their children.

9.1 Conners Rating Scales (CRS).

Because of their special place in the history of behavioral rating scales and their widespread usage, the various Conners Rating Scales (CRS) deserve detailed consideration. Only recently have they become commercially available. Prior to this time they were freely dispensed at an appreciable expense to the developer. It seems fair to say that Conners has stimulated many others to emulate him as indicated by the great number of rating scales now on the market, most of which contain his original items in one form or another.

The original CRS (teacher and parent forms) have been used more widely in clinical practice and research than any other scales. Also, DSM criteria include many of the original items on the CRS. The original scales were developed at Johns Hopkins in the sixties, and the intent was "to provide a comprehensive checklist of behavior problems commonly noted by parents and teachers of school age children" (Conners, in press).

The first parent scale contained 78 items grouped under categories such as problems in sleeping and eating, temper tantrums, and problems with friends. Conners later added 15 items assessing hyperkinetic, impulsive, and inattentive children. The corresponding teachers version contained only 39 items.

Because a briefer form was needed for monitoring children, particularly those on medication, Conners prepared a 10-item form that came to be known as the Hyperkinesis Index. This scale was comprised of the 10 most highly loaded items from factor analyses done on the parent and teacher scales. Subsequently, this Abbreviated Conners Scale, as it is often referred to, was shown to have two factors, one measuring aggressiveness and the other inattention-hyperactivity (Milich and Fitzgerald, 1985; Milich et al., 1982).

All the Conners scales are symptom checklists with a 4-point Likert format. Each item is rated by frequency of occurrence in the last month as Not at all, Just a Little, Pretty Much, or Very Much. In general, ratings of Pretty Much or Very Much represent clinically significant levels of symptomatology. The latest CRS scales are a 93-item Parent Rating Scale (PQ-93), a 39-item Teacher Rating Scale (TQ-39), a 48-item Parent Rating Scale (PQ-48), and a 28-item Teacher Rating Scale (TQ-28). Conners (in press) states that the latter two scales are a later revision and are not a perfect subset of earlier scales, although the content and wording are similar to earlier scales. Conners (in press) further states that:

> "Scoring is based on summing unit weights of individual items according to the factor structure of the scales. All forms are "Quick-Score" forms in which choices carry through to a second page for adding columns to obtain raw scores. The reverse side of the page provides a table for translating raw scores to T-scores."

The factor scores of the various scales are based upon items with loadings of 0.40 or greater. This results in some correlation of the factor scores so that some items load on more than one scale. While factors are orthogonal (not correlated) if one uses Varimax Rotation, factor scores are correlated because the items nearly always (or always) load (measure) more than one factor. As an example, several items show up on both the PQ conduct disorder and hyperactivity factors.

While the CRS were all developed on the basis of local norms, they have been so widely used both in this country and abroad as to qualify for national and international standardization. Conners is currently in the process of obtaining national normative data.

The norms for PQ-93 were originally based on 316 clinic patients and 365 matched normal children, the latter chosen from parents attending PTA meetings in Baltimore. Hence, neither sample can said to be representative of referred or nonreferred children in other parts of the U.S. The following quotes from Conners (in press) describe some of the normative data.

> "In the original development of the TQ-39, Conners (1969) factor-analyzed responses from a clinical sample of 82 boys and 21 girls. Werry and colleagues (Werry, Sprague, & Cohen, 1975) replicated the factor analysis in a group of normal children, and subsequently developed norms for the TQ-39 for a New Zealand sample (Werry & Hawthorne, 1976). Trites et al. (1982) developed the most comprehensive norms, using a stratified sample of 9583 Canadian children.
>
> A stratified random sample of parents interviewed in Pittsburgh provided the norms for the TQ-28 and PQ-48 (Goyette et al., 1978). In that study, 518 mothers and 373 fathers completed the PQ-48. The items in the PQ-48 were the highest-loaded items from earlier factor analyses, with a few items slightly reworded for readability. Norms for both the TQ-28 and PQ-48 are included for children from 3 to 17.
>
> Norms are available for various national groups including Brazil, Hong Kong, Italy, New Zealand, China, Spain, and West Germany (see Conners, 1989, for references)...
>
> Data for the TQ-39 include both sex and age norms, in groupings from 3-5, 6-8, 9-11, and 12-14 years. The PQ-93 norms vary only slightly as a function of age and SES (Conners, 1970), so that factor score norms combine results for ages 6 through 12.
>
> Trites et al.(1982) provided norms for 4 to 12 year-olds, separated by gender. Based on their analysis of the 39 items, the TQ-39 includes scales (item-group descriptors) of Hyperactivity (HA), Conduct Problem (CD), Emotional (E), Anxious-Passive (AP), Asocial (A), and Daydreaming-Inattention (DA).
>
> The TQ-28 includes scales for a) Conduct Problem; b) Hyperactivity; and c) Inattentive-Passive. Normative data for the TQ-28 are based on a study of 383 children, aged 3 to 17, separated by gender. Initial results on the revision of the TQ-39, the TQ-28, were presented by Goyette et al. (1978). This short form is not a strict subset the TQ-39. Instead, the TQ-28 was developed after a careful consideration of accumulated evidence on the psychometric properties of the original versions and represents a more abbreviated formulation of child behavior problems...

The Canadian norms from the Trites et al. studies (1982) comprise a total population of all primary schools in the city of Ottawa. The Pittsburgh norms came from a stratified random sample based upon census information available at that time. Neither sample excluded children on the basis of known psychopathology or learning problems" (Conners, in press).

Tables 9.1.1 and 9.1.2 present validity data as summarized by Conners (in press) in the same article from which all information in this section is derived (reproduced by permission of the author). Readers should note the high correlations of CRS with DSM-III-R and the externalizing scales of Achenbach's CBCL. Conners concludes that the 10-item abbreviated scale is as efficient as the entire DSM-III-R criteria set for diagnosing ADHD. Conners discusses in some detail measures of discriminant, concurrent, convergent, predictive, and criterion-related validity. His scales do as well as can be expected for rating scales on all these measures. The scales are also satisfactory with respect to various measures of reliability (test-retest and internal consistency).

Table 9.1.1 Validity studies of the hyperactivity index (Conners, in press).

AUTHORS	SAMPLE	FINDINGS
(Lambert, Sandoval, & Sassone, 1978)	Representative sample of S.F. school children (N=5212)	Behavior and Temperament Survey Correlated 0.89.
(Zentall & Barack, 1979)	Mixed population, but mainly regular ed. classroom children	David Hyperkinetic Scale r= 0.84.
(Sandoval, 1981)	Normal school children	Behavior and Temperament Survey r=0.89 (N=672), School Behavior Survey r=0.76 (N=95)
(Prinz, Connor, & Wilson, 1981)	68 1-3 graders deemed most disruptive and 136 normal controls	Hyperactivity rating on Daily Behavior Checklist r=0.87; Aggression rating on DBC r=0.65.
(Christie, Kaltenbach, & Reed, 1984)	34 children referred for impulsivity/hyperactivity	Safer & Allan's Classroom Teachers Behavior Checklist r=0.81; Werry-Peters BRS (parent) r=0.15; MFFT on sign. correlation. Direct observations of out-of-seat behavior r=0.44
(Horn, Conners, Wells, & Shaw, 1986)	20 inpatient ADHD/Conduct Disorders	Abikoff Classroom Observation Coding: Interference r=0.83, Solicitation r=0.60, Gross Motor r=0.58, Minor Motor not sign., Off-Task r=0.51.
(Reynolds & Stark, 1986)		No correlation with MFFT
(Whalen, Henker, & Finch, 1981)	Hyperactive children in summer treatment program	Staff: positive correlation with negative incidents, improved handwriting and naming; Teacher: positive correlation with same as above except handwriting
(Whalen, Henker, Collins, Finch, & Dotemoto, 1979)		Correlation with direct observation of discrete behavioral acts and verbalization, disruptive, off-task, inattention
(Edelbrock & Rancurello, 1985)	104 "disturbed" boys	CBCL AGG r=0.82 CBCL N-O r=0.60 CBCL INA r=0.58 CMCL EXT r=0.87
(Newcorn, Halperin, Healey, O'Brien, et al., 1989)	85 predominantly Black and Hispanic	DSM3-R Rating Scale: r=0.92

Table 9.1.2 Validity studies of TQ-28 and PQ-48 (Conners, in press)

AUTHORS	SAMPLE	FINDINGS
(Edelbrock & Rancurello, 1985)	104 "disturbed" boys	CBCL AGG with TQ-28 CD r=0.90 CBCL N-O with TQ-28 HA r=0.62 CBCL AGG with TQ-28 HA r=0.83 CBCL INA with TQ-28 I-P r=0.76 Total TQ-28 with Total CBCL r=0.85 Total TQ-28 with CBCL EXT r=0.89; with CBCL INT r=0.34
(Cohen, 1988)	135 consecutive referrals to Neuro clinic	TQ-28: CD with RBPC CD r=0.87; HA with RBPC AP r=0.65; ANX with RBPC A-W r=0.70; HA with RBPC CD r=0.77
(Newcorn, et al., 1989)	85 predominantly Black and Hispanic	DSM3-R Rating Scale and TQ-28 factors: HA r=0.89 I-P r=0.79 CP r=0.79
(Kazdin, Esveld-Dawson, & Loar, 1983)	32 Inpatients	High negative correlations of CP, HA, and I-P with teacher and rater-observed on-task rating and positive correlations with ratings of disruptive behavior
(Halperin, et al., 1988)	72 nonreferred children from grades 1-6	I-P correlated with CPT Omissions and X-only Commissions; CP correlated with CPT A-not X Commissions; HYP correlated with CPT A-not X Commissions

Conners points out that the most common mistake of unqualified users (persons failing to adhere to standards developed by the American Psychological Association, the American Educational Research Association, and the National Council on Measurement in Education) is that of diagnosing children on the basis of scale information alone. Scale results should be considered in the context of all information one has about a child.

Anyone using the commercial versions of the tests should thoroughly study Chapter 3 ("Interpretation") of Conners User Manual. This chapter discusses "threats to validity" that must be addressed in interpreting the scales. Conners states that the user should inspect the overall pattern of item responses to clarify ambiguities and inconsistencies. He also suggests that much can be gained by comparing multiple sources: teacher-parent and parent-parent ratings. A number of cluster studies which suggest that the Conners scales can be reliably interpreted in terms of "loadings" of a child on two or more clusters.

Conners and Wells (1986) found five relatively clear clusters in a cluster analysis of factor scores derived from the PQ-93: children with a normal childhood behavior pattern; a group with loadings on Antisocial, Learning Problem, and Conduct Disorder factors (possibly a delinquency cluster); children with loadings on Anxious-Shy, Psychosomatic, and Hyperactive-Immature factors (internalizing); a Hyperkinetic group with elevations on the Restlessness-Disorganized factor and moderate elevations on

the Hyperactive-Immature and Conduct Disorder factors; and a group with elevations on the Obsessive-Compulsive or Perfectionistic factor.

Taylor et al. (1986) did a cluster analysis on Taylor and Sandberg's (1984) TQ-39 factors plus laboratory measures, and child and parent interview information. They found four relatively clean groupings of subjects: Classroom Conduct Problems, Hyperactive, Anxious, and Depression. Hyperactivity was distinguished by elevations on all laboratory measures of hyperactivity, endorsements on interviews, and an elevated TQ Hyperactivity score. Klein and Young (1979) isolated a similar set of clusters.

Conners discusses the issue of diagnostic precision, saying that early studies with the Parent Questionnaires indicated a diagnostic efficiency of only about 70-80%, which he states is adequate for screening but not for diagnosis. But diagnostic precision has increased over the years, and he cites a later study by Satin et al. (1985) yielding better results. Satin et al. studied the diagnostic efficiency of the Hyperactivity Index and reported that 90% of 6-9 year old children diagnosed as hyperactive by the Hyperactivity Index were diagnosed as ADD by DSM-III one year later. Moreover, a 5-item subtest correctly classified 91% of the hyperactive children and 73% of the nonhyperactive subjects. Thus, specificity is better than sensitivity.

The Hyperactivity Index is the widest used metric in measuring treatment outcomes, particularly qualitative drug effects. Conners states that perhaps the second most commonly used scales are the Hyperactivity Factors from the parent or teacher forms. In monitoring drug effects, Conners strongly advocates the use of scales assessing side effects. He mentions one developed by NIMH in 1973, abbreviated TES (Treatment-Emergent Side Effects).

It has been found that there is a tendency for factor scores or Hyperactivity Index scores to decrease between the first and second administration (Milich et al., 1980). **It is recommended that at least two baseline measures be collected to prevent an overestimation of treatment effects.**

The Conners Scales, as stated above, have been more widely used in studying ADD/ADHD children than any other scales. Therefore, if an investigator wishes his data to compare with that of other studies, the Conners Scales should be included, and particularly the 10-item Hyperkinesis Index, which is also referred to as the Abbreviated Teacher or Parent Rating Scale since it can be used with both teachers and parents. This step does not preclude the use of other newer scales, many of which have used the Conners scales to establish convergent validity.

9.2 Assessment Scales That Have Extensive Normative Data.

This section describes in detail three sets of scales for which there is extensive normative data based on national samples.

Achenbach Rating Forms. Achenbach's Scales are the best known and most frequently used of all rating scales with national norms. The following table (Table 9.2.1) from Achenbach (1991d) outlines his basic assessment tools. It will be noted that sources of information vary with the age of the child. For brevity, child or children in this context also includes adolescents.

Table 9.2.1 Examples of Multiaxial Assessment Procedures

Approx. Age Range	Axis I Parent Reports	Axis II Teacher Reports	Axis III Cognitive Assessment	Axis IV Physical Assessment	Axis V Direct Assess. of Child
2-4	CBCL/2-3[a] CBCL/4-18 History Parent interview	Preschool records Teacher interview	Ability tests Perceptual-motor tests Language	Height, weight Medical exam Neurological exam	Observations during play Interview
5-11	CBCL/4-18 History Parent interview	TRF School records Teacher interview	Ability tests Achievement tests Perceptual-motor tests Language tests	Height, weight Medical exam Neurological exam	DOF[b] SCIC[c]
12-18	CBCL/4-18 History Parent interview	TRF School records Teacher interview	Ability tests Achievement tests Perceptual-motor tests	Height, weight Medical exam Neurological exam	DOF[b] YSR Clinical interview Self-concept measures Personality tests

[a]CBCL/2-3 = Child Behavior Checklist for Ages 2-3 (see McConaughy & Achenbach, 1988)
[b]DOF = Direct Observation Form (see McConaughy & Achenbach, 1988)
[c]SCIC = Semistructured Clinical Interview for Children (see McConaughy & Achenbach, 1990)

Achenbach originally developed separate instruments for obtaining parent, self, and teacher ratings. The parent version (CBCL/ 4-16) was the basis for each of the others (pre-1991 editions). In 1991, the age range of the CBCL was extended to 18 and the parent version is now denoted CBCL/4-18 (Achenbach 1991a). Competence and problem scales were constructed for all forms: CBCL/4-16, Teacher Rating Form (TRF), Youth Self-Report Form (YSR), and CBCL/2-3 (another parent form). In a series of elaborate analyses, which are detailed by Achenbach (1991c), syndrome scales were developed common to the CBCL (two parent forms), TRF, and YSR. Separate norms are provided for children of different ages and both sexes.

The competence scales on the various forms are designed to reflect behavior that is important for successful adaptive development. The YSR competence items are similar to those of CBCL, but the YSR does not include items about school performance that can be better answered by teachers and parents. The adaptive functioning parts of the TRF differ from those of other scales because teachers are not likely to know the activities that occur outside the school environment. The competency items were chosen on the basis of pilot research (Achenbach and Edelbrock, 1981, 1983).

The behavioral/emotional problem items of the CBCL were also developed through several research and pilot editions (Achenbach, 1966, 1978; Achenbach and Edelbrock, 1981, 1983). The YSR and TRF problem items are very similar to those of the CBCL (minor changes in wording).

The CBCL/4-18 can be filled out by most parents who have at least 5th grade reading skills (completion time on the average is 15-17 minutes). Items are read and if necessary explained to parents who have less than 5th grade reading skills. Competence is assessed on the CBCL/4-18 by asking parents to specify sports and other activities their child is engaged in, e.g., clubs, teams, and groups your child belongs to, jobs or chores your child has, number of class friends your child has, etc.

There are 113 problem-behavior items on the CBCL/4-18, each rated on a 3-point scale: 0=not true (as far as you know); 1=somewhat or sometimes true; and 2=very true or often true. Of the problem items, 89 are common to CBCL, TRF, and YSR.

The YSR (Achenbach, 1991) is normed for ages 11-18. The YSR is designed to be self-administered to youths whose mental age is at least 10 with 5th grade reading skills. Test-taking time is about 15 minutes.

The TRF, similar to the CBCL, has norms for children and youth 5-18 years of age (Achenbach, 1991b). Test completion time averages about 10 minutes for the 113 items. The TRF profile for adaptive functioning yields normalized scores for academic performance, working hard, behaving appropriately, learning, and happy.

The syndrome scales are divided into two main groups, Internalizing and Externalizing syndromes. Syndrome as used by Achenbach refers to a group of practices (items) that tend to co-occur and were identified by component and/or factor analysis. The three syndrome scales that form the Internalizing grouping are Withdrawn, Somatic Complaints, and Anxious/Depressed. The Externalizing syndromes are Delinquent Behavior and Aggressive Behavior. There are three other syndromes that did not show consistently strong association with Internalizing or Externalizing - social problems, thought problems, attention problems. Each form, teacher, parent, or youth, has a list called Other Problems that did not load on any of the eight syndromes. Syndromes are scored in T scores with a mean of 50 and a standard deviation of 10.

The Internalizing and Externalizing Scales were derived by a second order factor analysis of the pre-1991 scales. These were separately done for each sex/age group on the CBCL, YSR, and TRF. Each analysis yielded two groupings of syndrome scales corresponding to anxious-inhibited and aggressive, antisocial behavior. These were labeled Internalizing and Externalizing when first developed (Achenbach, 1966). A similar but more rigorous methodology was used in developing the Internalizing and Externalizing Scales in the 1990-91 forms (see Achenbach, 1991d, Integrative Guide). Achenbach (1991d) noted that a child can be both Internalizing and Externalizing (i.e., have both kinds of problems). In the Achenbach normative sample, the two second order factors correlated 0.52; that is, children high in Internalizing also tend to have higher scores on Externalizing and vice versa.

The table below is taken from Achenbach (1991d). It is an interesting way of representing agreement among different judges. As may be seen the odds ratios for parents are higher than those for other combinations of raters. For example, if a mother rates one of her children as withdrawn, the odds are 11:6 that the father will also score the same child as withdrawn. On the surface, 11:6 may not appear to be all that great (65%). However, odds are based on both parents placing a child in an extreme category. Odds were defined in terms of syndrome scores being in the borderline (T scores of 67 to 70)

or clinical range (T-scores greater than 70); i.e., children who score above the 95th percentile on any given clinical syndrome. Two other points worthy of noting in reviewing the table are: 1) all but 3 odds ratios are statistically significant; 2) the highest odds ratios are for externalizing and thought problems.

Table 9.2.2 Odds Ratios for Relations Between Informants' Ratings in the Normal versus Clinical Range

Scale	Mother x Father	Parent x Teacher	Parent x Self	Teacher x Self
	N=599	2,274	1,470	1,036
Withdrawn	11.6	5.5	5.3	3.8
Somatic Complaints	11.5	2.7	5.6	(1.4)
Anxious/Depressed	15.7	4.8	4.4	3.1
Social Problems	21.3	11.0	10.4	9.5
Thought Problems	10.4	4.8	3.4	(1.5)
Attention Problems	23.5	6.8	5.5	2.4
Delinquent Behavior	40.2	8.7	9.2	8.0
Aggressive Behavior	28.0	9.8	5.1	6.7
Internalizing	12.0	3.6	3.0	2.4
Externalizing	38.6	5.2	4.8	3.4
Total Problems	25.9	5.5	3.3	2.5

Note. Confidence intervals showed that all odds ratios exceeded 1.00 at $p < .01$, except Teacher x Self scores for Attention Problems, which was significant at $p < .05$, and the two in parentheses, which were not significant.

Users should carefully read Achenbach's four manuals, and particularly the one entitled Integrative Guide for the 1991 CBCL/4-18, YSR, and TRF. (Achenbach, 1991d).

The normative samples on which the various forms are based are substantial. The normative sample for the newest scale, the CBCL/2-3 (Achenbach, 1992), consisted of 183 children 2- and 3-year old who resided in the same households as the national sample of 4-18 year old children and youth (sex x group sizes ranged from 37 for 2 year old girls to 62 for 3 year old boys). To make all sizes more uniform, Ss were added from the general population that had been used to norm the 1986 profile; this increased the total N to 368 (2 years x 2 sexes x 96). Test-retest reliability, split-half reliability (internal consistency), and inter-rater (two parents) were all very good for children 2-3 years old. Likewise, the different measures of validity were equally good (content, construct, discriminant, and criterion).

The CBCL/4-18 is based on a national epidemiological sample of 2,368 children (581 boys ages 4-11, 564 boys ages 12-18, 604 girls ages 4-11, and 604 girls ages 12-18). They represented all social classes, ethnic groups, and regions of the U.S. All reliability measures (interparent agreement and stability) and validity measures (content, construct, criterion, discriminant) were very good for rating scales. All quantitative scale scores differentiated between referred and nonreferred children after controlling for the effects of demographic variables.

Normative data for the TRF utilized a subsample of subjects in the national sample assessed with the CBCL/4-18 (McConaughy, Stanger and Achenbach, 1991). Completed TRFs were obtained from

1,613 teachers (each paid $10 for completing the teacher rating). Test-retest reliability scores, 2nd and 4-month stability scores, and inter-teacher agreement were satisfactory. Validity was assessed, as with the other forms, in a number of different ways (content, construct, criterion-related, classification of pupils according to clinical cutpoints, and by comparison of referred and nonreferred samples).

The YSR is based on a subsample of the national sample (637 boys ages 11-18 and 678 girls ages 11-18). This form contains one syndrome (fractural) not showing upon other scales (self-destruction/identifying problems occurring only in boys). The same kinds of reliability and validity measures are reported as for the other forms (CBCL, TRF).

The CBCL/4-18, YSR, and TRF assess in some degree the main components of Public Law 94-142: inability to learn, inability to maintain relationships, pervasive mood of unhappiness, and tending to develop physical symptoms. These are assessed by attention problems, aggressive behavior problems, thought problems, anxious/depressed, and somatic complaints.

Behavior Assessment System for Children (BASC). This scale was not available at the time Barkley (1990) wrote his book. The developers of this scale are Reynolds and Kamphaus (1992). The BASC is a multimethod assessment system which contains a self report form, two rating scales, one for teachers and one for parents, a structured developmental history, and a form for recording and classifying directly observed classroom behavior. The scales were designed "to facilitate the differential diagnosis and educational classification of a variety of emotional and behavioral disorders of children and to aid in the design of treatment plans" (Reynolds, 1992, p.1).

Composite scores and scales in the Teacher Rating Scale (TRS) and the Parent Rating Scale (PRS) are summarized. These scales assess in preschool children, school children, and youth Externalizing problems (aggression, hyperactivity, and conduct problems), Internalizing problems (anxiety, depression, somatization), school problems (attention and learning), adaptive skills (adaptability, leadership, social skills, study skills), and other problems (atypicality and withdrawal). Atypicality refers to thought problems (e.g., "I cannot control my thoughts"), compulsive behavior (e.g., "I cannot stop myself from doing bad things") and related items. The forms contain items which are rated on a four-point scale of frequency (never to almost always).

The teacher rating scales (TRS) come in three forms with items written at three age levels: preschool (4-5), child (6-11), and adolescent (12-18). Each item is rated on a 4-point scale ranging form Never to Almost Always. The Parent Rating Scale (PRS) is similar to the TRS (three forms) and is scored in the same way. The Self-Report of Personality (SRP) assesses various clinical syndromes (see Table 1 above). It has forms for two age levels (8-11 and 12-18). These levels overlap considerably in format.

The Structured Developmental History (SDH) is a history and background survey that is filled out by the clinician as he interviews the caregiver. The Student Observation System (SOS) is a form for categorizing classroom behaviors. It utilizes the technique of time sampling (systematic coding of behaviors during 3-second intervals spaced 30 seconds apart over a 15-minute period).

An interesting feature of the BASC is that it contains both general and clinical norms as well as male-female norms; i.e, there are four possibilities for selecting norms--male, female, general, and clinical. The general norms are based on a large national representative sample of the general population of children in the U.S.: 116 testing sites mostly from the South, East, and Central States with a neglect of the Pacific Northwest (N= 2401 for TRS, 3483 for PRS, and 9861 for SRP). Clinical norms are

based on a representative sample of children being served in school or clinical settings for emotional or behavioral problems: samples were collected at 32 sites in the U.S. and at 3 sites in Canada (N= 693 for TRS, 401 for PRS, and 411 for SRP). The test developers argue that the behavior ratings of children who have significant problems are often so much higher than the ratings of nonreferred children that ceiling effects are encountered. If the intent of these instruments is to use them as a stepping stone in the diagnostic process, ceiling effects for clinical cases should not be a problem. However, if the intent is to reliably rate varying degrees of abnormality in clinical subjects, ceiling effects are a problem.

An excellent feature of the BASC manual is that it gives elaborate instructions for administration and scoring, and these should be carefully noted by anyone who wishes to use this instrument. The reading level of the items was analyzed (see manual for details), and it is reported that a third grade reading level is sufficient to comprehend the items on the parent and self-report rating forms. Like some of the more sophisticated scales in psychology, the BASC provides scales to check for faking good or bad and a validity index. The fact that the majority of patients seen in child guidance clinics have disruptive behavior disorders is supported by their norms--the most prevalent diagnosis was behavior disorder.

All of the subtests have satisfactory internal consistency (degree to which items on a scale are measuring the same domain of behavior), test-retest reliability (stability of results over time), and interrater reliability (degree of agreement of different raters). There is considerably less agreement, however, between different raters than for the same teacher rating the child on two different occasions. The test developers suggest three reasons for this. First, different teachers may interpret the items in different ways. Second, different teachers may have formed different impressions of the child and their general impression carries over to all the items they rate. Third, and perhaps most important, children behave differently in different settings.

The factor structure of the scales was determined by a confirmatory factor analysis, which was used not to confirm the hypothesized starting model (test items were originally developed around certain basic constructs by experts in the field) but to evaluate the model and modify it in appropriate ways. The developers found that their starting model was not as good a fit of the factor structure as they had hoped for.

The teacher rating form contains 3 factors for preschool children (internalizing and externalizing problems and adaptive skills). The teacher rating form for children and adolescents yields 4 factors: the 3 just listed for preschool children and a separate one called school problems. The latter is assessed by scores on attention problems, learning problems, study skills, and, to a lesser extent, hyperactivity, which has a much larger loading on externalization problems. It is interesting that the correlation of inattention and learning problems was higher than the correlation of either of these with aggressive, conduct problems, and hyperactivity. This lends credence to our earlier supposition that attention per se is as much a problem for LD children as for ADHD children (Dykman et al., 1971). Two of the scales assessing internalizing problems on the TRS (child and adolescent form) overlap the adaptive skills factor (adaptability and withdrawal).

For external validation, the teacher rating forms (TRS) were correlated with five other rating forms: Teacher Report Form (Achenbach, 1991); Revised Behavior Problem Checklist (Quay & Peterson, 1983); Conners (1989) Teacher Rating Scales; Burks (1977) Behavior Rating Scales; and the Behavior Rating Profile (Brown & Hammill, 1983).

In general, the TRS scales and composites correlate satisfactorily with these other scales, and particularly so for scales in which there is a direct correspondence. The highest intercorrelation was obtained for scales measuring externalizing and school problem behaviors.

Reliability and validity are satisfactory for the parent forms, generally in a good to excellent range. There is good evidence that the parent form can be used to assess externalization, internalization, and adaptive skills as with the teacher form, however, there is some overlap: attention problems load on both adaptive skills and externalization; atypicality (e.g., "I have many accidents", "I hear voices in my head") and depression load on both internalization and externalization; and withdrawal loads on both internalization and adaptive skills.

The PRS was correlated with four other scales: Child Behavior Checklist (Achenbach, 1991); Personality Inventory for Children-Revised (Lachar, 1982); Conners Parent Rating Scales (Conners, 1989); and the Behavior Rating Profile (Brown & Hammill, 1983). High correlations were obtained with the CBCL and with the externalizing scales of the Conners parent form.

The Self-Report of Personality looks very good for a self-report scale: the two reliability measures were high--internal consistency and test-retest. The factors assessed by this scale are somewhat different than those for the teacher and parent forms. Three factors emerged from a principal-axis factor analysis using both varimax and oblimin rotations: clinical maladjustment, personal adjustment, and social maladjustment. The SRP was correlated with several other rating scales: Minnesota Multiphasic Personality Inventory (Hathaway & McKinley, 1943); Youth Self-Report (Achenbach, 1985); Behavior Rating Profile (Brown & Hammill, 1983); Children's Personality Questionnaire (Porter & Cattell, 1975). Parts of each of these validation scales exhibited a number of high correlations with the SRP providing support for construct validity.

Correlations between teacher and parent forms (N=1423 children) are low to moderate and increase with the age of the child - the authors summarize their results as follows:

> "At the preschool level, the median correlation between corresponding scales is .24 and the range is from .03 for depression to .42 for social skills. The composite score correlations are also modest, ranging from -.08 for Internalizing Problems to .43 for adaptive skills...The relationship between parent and teacher ratings at the child level is considerably stronger." (p.180)

The Attention Deficit Disorder Evaluation Scale (ADDES). There are two versions of this scale, a home version and a school version (McCarney, 1989a, 1989b). Included is a third manual that makes intervention recommendations targeted to the specific needs of the child. The Attention Deficit Disorders Evaluation Scale may be used to:

> "a) Screen for Attention-deficit Disorders;
> b) Provide a measure of Attention-deficit for any referred student;
> c) Provide information which may contribute to the diagnosis of Attention-deficit Disorders;
> d) Develop program goals and objectives; and
> e) Identify intervention activities for areas of Attention-deficit Disorders behavior or performance" (McCarney, 1989a, p. 4).

It is assumed by the test developer that no other person is in a better position to make ratings of behavior and learning than the classroom teacher. The items themselves are similar to those appearing on other rating scales but they are scored on the basis of frequency; e.g. rushing through assignments with little or no regard to accuracy or quality of work is scored 0 if child does not engage in this behavior, 1 if it occurs one to several times a month, 2 if it occurs one to several times a week, 3 if it occurs one to several times a day, and 4 if it occurs one to several times per hour. The scale as finalized consists of 60 items assessing inattentiveness, impulsive behavior, and hyperactivity. The author describes the overall methodology as follows:

> "For the purpose of development of the Attention Deficit Evaluation Scale-School Version, behavioral descriptors were gathered for the educational environment from diagnosticians and educators working with Attention-Disordered students. These behavior descriptors were clustered and factor analyzed according to the characteristics of Inattention, Impulsiveness, and Hyperactivity" (p. 7).

Later in the manual, it is said that a principal components analysis was used to see whether the three postulated subscales could be confirmed. Items assessing inattention, impulsiveness, and hyperactivity accounted for 69% of the variance and these items were retained. Of importance, three main factors were found with 27 items loading highest on inattentiveness, 18 highest on impulsivity, and 15 highest on hyperactivity. There was considerable overlap between factors suggesting that there are at least two subtypes, one with mainly attentional problems and a type in which hyperactivity and impulsivity predominate. The correlations between subscale scores, however, are highly significant, meaning that the raw scores defining the three scales are not independent; i.e., impulsive and hyperactive children tend also to be inattentive. The statistical analysis did not pinpoint a specific pure inattention type (ADD only) which might be revealed by other statistical procedures.

Normative data were gathered from 4,876 students, ages 4 to 20 years, from 78 public school systems in 19 different states representing all regions of the U.S. The sample was reasonably representative of the various important demographic parameters (sex, race, parent's occupation, rural-urban residence, and grade level). This was an epidemiological sample with the students rated by 1,567 teachers. It was found that males received higher scores on all subscales than females (no surprise), and, in conformity with other work, that symptoms tended to abate with aging.

Ratings of reliability were excellent (inter-rater, internal consistency, and standard error of measurement). Validity measures were also acceptable (content, item/total score correlations, discriminant validity, criterion validity, and construct validity). All of the foregoing statistics indicate that the rating scale is reasonably reliable and valid.

The home (parent) version is very similar to the school version, and the normative data are derived from 1,754 children and youth from 12 states representing all regions of the country. In all 2,089 students were involved...with 3,172 parents rating the students. The home version consists of 46 items measuring the same three behaviors as the teacher form--19 items for attention, 15 items for impulsivity, and 12 items for hyperactivity. Measures of reliability and validity were comparable to those for the teacher form, and the items were derived in the same way. The home version has separate norms for boys ages 4-6, 6-7, 7-11, 11-16, and 16-20. It contains comparable norms for females but with fewer subjects and the two older age ranges are collapsed into one of 11-20. These tables can be used to translate raw scores on each scale (inattention, impulsivity, and hyperactivity) to standard scores. The age norms for the teacher version are different: ages 4-6, 8-11, 11-16, and 16-20 for boys and 4-9, 9-10,

10-16, and 16-19 for girls. These variations in age norms are probably attributable to sampling limitations in some age groups.

Inter-rater reliability was checked using 172 pairs of parents. The interesting question here is the degree of agreement among parents as well as the reliability of the instrument. The degree of parent agreement was impressive, with coefficients ranging from 0.80 for ages 14 to 20 to .84 for children ages 4-8. These coefficients are for the total test score. Data for parental agreement on the separate scales are not given.

9.3 Additional Rating Instruments Useful in Assessment.

We have included three additional instruments which are useful in assessing children with ADHD. The DuPaul ADHD Rating Scale, Pelham's Disruptive Behavior Disorders Rating Scale (DBD), and the Children's Global Assessment Scale (CGAS) (Shaffer et al., 1985). The DuPaul scale and the CGAS were used in the DSM-IV field trials. The DBD Rating Scale is a new scale that includes not only ADHD symptoms but also the other disruptive behaviors classified in the DSM-III-R.

DuPaul ADHD Rating Scale. This rating form is included here because we believe it is a very valuable first-stage classification tool. The 14 DSM-III items that are used to classify children as ADHD have been abbreviated by DuPaul to fit into the format of a rating scale (DuPaul, 1990). The scale provides separate norms for parents and teachers. It covers the age range 6-12. Norms were computed from the returns of 765 parents and 551 teachers. Test-retest reliability, internal consistency, discriminant, and concurrent validity measures are acceptable. The scale enables one to make both a categorical diagnosis (ADHD yes or no) and a dimensional one (degree of severity of symptoms). Age-norms are available for all years from 6 to 12. Barkley (1990) explains how scores on this scale should be interpreted.

> "Scores of 2 or higher are considered to be inappropriate for a child's developmental level, and a quick count of the number of items with such scores [2 or higher] can determine whether the child exceeds the 8 of 14 criteria recommended by the DSM-III-R. However, based on the norms gathered by DuPaul (1990a), the 8-of-14 figure appears to be satisfactory for girls but too liberal for boys, resulting in over identification of ADHD in the population. This suggests that different cutoff scores for boys and girls should be used. A cutoff of 10 of 14 seems more appropriate for boys, based on the data." (p.310)

ADHD RATING SCALE

Child's Name_____ **Age**_____ **Grade**_____

Completed by _____

Circle the number in the one column which best describes the child.

	Not at all	Just a little	Pretty much	Very much
1. Often fidgets or squirms in seat.	0	1	2	3
2. Has difficulty remaining seated.	0	1	2	3
3. Is easily distracted.	0	1	2	3
4. Has difficulty awaiting turn in groups.	0	1	2	3
5. Often blurts out answers to questions.	0	1	2	3
6. Has difficulty following instructions.	0	1	2	3
7. Has difficulty sustaining attention to tasks.	0	1	2	3
8. Often shifts from one uncompleted activity to another.	0	1	2	3
9. Has difficulty playing quietly.	0	1	2	3
10. Often talks excessively.	0	1	2	3
11. Often interrupts or intrudes on others.	0	1	2	3
12. Often does not seem to listen.	0	1	2	3
13. Often loses things necessary for tasks.	0	1	2	3
14. Often engages in physically dangerous activities without considering consequences.	0	1	2	3

The ADHD Rating Scale. From *The ADHD Rating Scale: Normative Date, Reliability, and Validity* by G.J. DuPaul, 1990, unpublished manuscript, University of Massachusetts Medical Center, Worchester.

Children's Global Assessment Scale (CGAS). This scale developed by Shaffer et al. (1985) is for children 4-16 years of age. The examiner rates the subject's most impaired level of functioning for a specified time period by selecting the lowest level of functioning in that period of time. Functioning is rated say for a one month period regardless of treatment or prognosis. There are 10 categories with each covering a score range of 10 points (total score can vary from 1 to 100. Examples of categories high, middle, and low on the list follow as quoted directly from the article.

"Specified time period: one month.

> 100-91 **Superior functioning in all areas** (at home, at school, and with peers); involved in a wide range of activities and has many interests (e.g., has hobbies or participates in extracurricular activities or belongs to an organized group such as Scouts, etc.); likeable, confident; "everyday worries never get out of hand; doing well in school; no symptoms...

60-51 **Variable functioning with sporadic difficulties or symptoms in several but not all social areas;** disturbance would be apparent to those who encounter the child in a dysfunctional setting or time but not to those who see the child in other settings...

10-1 **Needs constant supervision** (24 hour care) due to severely aggressive or self-destructive behavior or gross impairment in reality testing, communication, cognition, affect, or personal hygiene" (pp. 747-48).

We think that it is important to rate global functioning with a scale such as the CGAS, but also to rate academic and home functioning separately with the DuPaul and Barkley scales described above. This instrument was used in the DSM-IV field trial as one means of deriving cutscores for ADD children who are and who are not hyperactive (personal communication from Dr. Benjamin Lahey).

The Disruptive Behavior Disorders Rating Scale (DBD). Pelham et al. (1992) have developed a teacher rating scale for the DSM-III-R Disruptive Behaviors which includes ADHD, Conduct Disorder (CD) and Oppositional-Defiant Disorder (ODD). This scale is particularly useful because it considers the other disruptive disorders which frequently overlap ADHD. Pelham et al. (1992) used this scale to provide estimates of the prevalence rates of the different disruptive behavior disorders (see section 8.0).

The DBD scale is composed of the 36 diagnostic criteria in the DSM-III-R; 14 items for ADHD, 9 items for ODD and 13 items for CD. In the 1992 article, information was gathered on a nationwide sample targeting teacher ratings of prevalence of the disruptive behavior disorders (N=931 boys age 5-14 attending regular classrooms). Statistical data are provided for the probability of a given symptom appearing given that a child has ADHD, ODD, or CD. The paper also presents data on the predictive rate positive; the probability of a disorder such as ADHD given a symptom such as "often talks excessively".

A factor analysis revealed three factors: one reflecting ODD which included several symptoms of CD, an purely inattentive type of ADHD, and the "classical" ADHD child (impulsivity/overactivity symptoms). The predictive rate positive for ADHD symptoms (as identified by ratings of "very much" on critical items) were, in general, poor predictors of ADHD. And not surprisingly at least to present reviewers, 6 of the 9 ODD symptoms had predictive rate positive greater-than 0.40 in predicting an ADHD diagnosis. On the whole, the ODD items did a better job of predicting the presence of ODD than the ADHD items in predicting the presence of ADHD. Viewed separately, combinations of symptoms from the two ADHD factors as well as combinations of symptoms from the ODD factor had high predictive power for these disorders. Hence, this scale would seem to be of considerable value in not only identifying ADHD, but in identifying children with ODD as well.

9.4 Direct Observational Techniques.

When possible, a member of the assessment team should observe the ADD child in his/her classroom on several different days and during different class activities (Fowler et al., 1992). The observer should make systematic ratings during consecutive 15-20 second intervals for 20-30 minutes. Behaviors to record include: off-task, fidgeting, out of seat without permission, vocalizing during work periods, playing with objects unrelated to assigned activity. Barkley (1990) has developed an efficient ADHD Behavior Coding System, which can be used in the classroom or in what he terms a restructed academic situation in the clinic. DuPaul (1990) has shown that these coded observations correlates highly with teacher ratings of ADHD symptoms as well as with measures of academic accuracy and productivity.

Fowler et al. (1992) recommend also that a record be made of the ADD child's classroom productivity. The person who serves as the classroom observer should obtain from the teacher direct evidence concerning the percentage of written work completed and the percentage completed correctly over a two week period. Alternatively, the teacher could be asked to complete the Academic Performance Rating Scale (DuPaul et al., 1990).

9.5 Summary/Critique.

Of all the new instruments currently on the market to assess ADHD, the BASC and ADDES would seem to be the best. Unfortunately, there is not as yet any research in which these two sets of scales have been used. The only other rating scales with comparable norms are the Achenbach scales which have been around much longer, and have the substantial advantage of having been used in a relatively large number of ADD/ADHD studies. None of the scales, however, has been used as frequently as the Conners scales in ADD/ADHD research, and it is fair to say that most newer scales contain Conners' original items in one form or another. A limitation of both the BASC and Achenbach scales is their length. Most teachers would probably prefer the Abbreviated Conners Teacher Rating Form (10 items) or the ADHD rating scale of DuPaul. For purpose of making a diagnosis of ADHD, the scale of DuPaul or the Abbreviated Conners Scale would seem to be best as first-stage instruments. For the purpose, however, of obtaining a better description of the individual child, the BASC, Achenbach, or longer Conners forms should be used. If DSM-III-R psychiatric diagnoses other than ADHD are to be assessed, we would recommend one of the diagnostic structured interviews to be described in the next section. If possible, the child should be directly observed in the classroom.

10.0 Structured Interviews.

The major interviews are listed in the table below.

Table 10.1. Attention Deficit Disorder Interview Schedules

Interview Name	Developer	Domains Assessed/Diagnosed
Behavior Screening Questionnaire (BSQ)	Richman, N.; Graham, P., 1971	health, behavior, and development of the child
Child Assessment Schedule (CAS)	Hodges, Kay; McKnew, Donald; Cytryn, Leon; Stern, Linda; Kline, Jeffrey, 1982	Content Area: School, Friends, Activities, Family, Fears, Worries, Self-Image, Mood, Somatic Concerns, Expressions of Anger, Thought Disorder. Symptom Complexes: Attention Deficit with Hyperactivity, Attention Deficit without Hyperactivity, Undersocialized Conduct-Aggressive, Undersocialized Conduct-Unaggressive, Socialized Conduct, Separation Anxiety, Overanxious, Oppositional, Depression
Child Screening Inventory (CSI)	Langner, T.; Gersten, J.; McCarthy, E. D.; Eisenberg, J. G.; Greene, E. L.; Herson, J. H.; Jameson, J. D., 1976	Self-Destructive Tendencies, Mentation Problems, Conflict with Parents, Regressive Anxiety, Fighting, Delinquency, Isolation

Interview Name	Developer	Domains Assessed/Diagnosed
Diagnostic Interview for Children and Adolescents-Revised-Adolescent Version (DICA-R-A)	Reich, Wendy; Shayka, Joseph; Taibleson, Charlotte, 1991	Age: 13-17 years Demographics, Attention Deficit Hyperactivity Disorder, Oppositional Defiant Disorder, Substance Abuse, Mood Disorders, Anxiety Disorders, Eating Disorder, Elimination Disorders, Gender Identity Disorder, Somatization
Diagnostic Interview for Children and Adolescents-Revised-Child Version (DICA-R-C)	Reich, Wendy; Shayka, Joseph; Taibleson, Charlotte, 1991	Age: 6-12 years Demographics, Attention Deficit Hyperactivity Disorder, Oppositional Defiant Disorder, Substance Abuse, Mood Disorders, Anxiety Disorders, Elimination Disorders, Gender Identity Disorder, Somatization
Diagnostic Interview for Children and Adolescents-Revised-Parent Version (DICA-R-P)	Reich, Wendy; Shayka, Joseph; Taibleson, Charlotte, 1991	Demographics, Attention Deficit Hyperactivity Disorder, Oppositional Defiant Disorder, Substance Abuse, Mood Disorders, Anxiety Disorders, Elimination Disorders, Gender Identity Disorder, Somatization
Diagnostic Interview Schedule for Children-Child Interview (DISC-C)	Costello, A. J.; Edelbrock, C. S.; Kalas, R.; Kessler, M.; Klaric, S., 1982	*Behavior/conduct* Conduct Disorder: Aggressive, Nonaggressive, Oppositional; Attention Deficits: Inattention, Impulsivity, Overactivity; *Affective/neurotic* Anxiety: Separation Anxiety, Overanxiety; Fears and Phobias: Simple Fears, Social Phobias; Obsessive-compulsive; Schizoid/psychotic; Affective: Affective Depression, Cognitive Depression, Vegetative Depression, Suicidal Depression
Diagnostic Interview Schedule for Children-Parent Interview (DISC-P)	Costello, A. J.; Edelbrock, C. S.; Kalas, R.; Kessler, M.; Klaric, S., 1982	*Behavior/conduct* Conduct Disorder: Aggressive, Nonaggressive, Oppositional; Attention Deficits: Inattention, Impulsivity, Overactivity; *Affective/neurotic* Anxiety: Separation Anxiety, Overanxiety; Fears and Phobias: Simple Fears, Social Phobias; Obsessive-compulsive; Schizoid/psychotic; Affective: Affective Depression, Cognitive Depression, Vegetative Depression, Suicidal Depression
Interview Schedule for Children	Kovacs, M., 1982	DSM-III diagnoses, especially affective disorders in childhood, and includes diagnostic addenda for diagnoses such as overanxious disorder and attention deficit disorder.
Mental Health Assessment Form (MHAF)	Kestenbaum, Clarice J.; Bird, Hector R., 1978	Physical Appearance, Motoric Behavior and Speech, Relatedness during Interview, Affect, Language and Thinking, Feeling States, Interpersonal Relations, Symbolic Representations, Self-Concept, Conscience- Moral Judgement, General Level of Adaptation

Interview Name	Developer	Domains Assessed/Diagnosed
Schedule for Affective Disorders and Schizophrenia for School-Age Children (K-SADS) (1986 revision)	Last, Cynthia, 1986 (adapted from Puigh-Antich and Ryan, 1986 revision)	Major Depression and Dysthymia, Mania and Cyclothymic, Anxiety Disorders, Separation Anxiety Disorder, Phobic Disorders, Overanxious Disorder, Obsessive-Compulsive, Avoidant Disorder, Somatization, Disruptive Behavior Disorders, Psychotic Symptomatology,
Semi-structured Clinical Interview for Children (SCIC)	Achenbach, T. M.; McConaughy, S. H., 1989	Inept, Unpopular, Anxious, Withdrawn-Depressed, Inattentive-Hyperactive, Resistant, Family Problems, and Aggressive.

The DISC has both a parent and self-report form. This instrument has undergone significant revisions in the past two years, and we have not as yet received updated information on the nature of these revisions. We understand that several papers are in preparation and will be submitted for publication this year. These instruments have been extensively field-tested and are devised to be administered by lay persons with a modicum of training. More attention has been paid to the reliability and validity of this instrument than is the case for other structured interviews.

The DISC was originally developed by NIMH for use in epidemiology studies of childhood psychopathology. It has a skip-type structure which reduces interviewing time for children with few symptoms. The parallel form for parents is referred to as the DISC-P. The items on these two forms cover most of childhood pathology as well as the onset, duration, and severity of symptoms. The instrument is supported by good reliability and validity data.

The DICA has also been recently revised and field trials for it are underway. While there are some data indicating that the older DICA and the corresponding parent form (DICA-P) are reliable and valid, the data are by no means as extensive as for the DISC. Our own feeling is that the revised DICA will prove to be very valuable in clinical practice. In general, the DICAs encourage the examiner to probe for information that goes beyond simple yes and no answers. Thus, it requires a bit more skill and training for persons to administer these interviews than the DISC interviews.

Despite various criticisms of the older DICA, it has been shown, as previously stated, to be of value in genetic studies of ADD/ADHD children, which attests to its validity. Gillis et al. (1992) used the DICA to assess ADHD in twins. The study utilized 37 identical and 37 fraternal twin pairs tested in the Colorado reading project. Results of the analysis indicated that ADHD as assessed by the DICA is highly heritable. Using a highly sophisticated regression model developed by other investigators in the Colorado group (Defries and Fulker 1988), coefficients of heritability were estimated to range from 0.87 to 0.98 depending upon adjustments for differences in IQ or reading. This implies that ADHD, as diagnosed by the DICA, is largely a biologically based heritable disorder.

The Kiddie-SADs (Puig-Antich and Chambers, 1978) is a briefer interview form than the two described above, but it has been widely used in research and clinical work. It is currently in its fourth revision, which was published in 1986. It is scorable in terms of DSM-III diagnostic criteria and Research Diagnostic Criteria for major affective disorders including symptoms associated with depression (e.g., suicidal ideation and social withdrawal) and other disorders of childhood (somatization, nondepressive neurotic disorders, conduct disorder, and psychotic disorder). The primary research use

of this instrument has been that of selecting children who satisfy criteria for depression. Its reliability and validity statistics are reasonable for an instrument of this nature.

The Interview Schedule for Children (Kovacs, 1982) has also been used in several clinical studies. This is a semistructured interview for children ages 8-17, and is designed to be administered by clinicians familiar with DSM-III diagnostic criteria. While the instrument has been designed primarily to diagnose depression, it can also assess anxiety disorders and ADD/ADHD. It involves separate interviews of the parent and child and takes about 40-60 minutes. As with the K-SADs, the interview begins with a nonstructured part to establish rapport and to determine the general nature of the current disorder. This is followed by a more structured symptom oriented clinical interview. The interview covers the severity of the current condition and 43 core symptoms (e.g., depressed mood and suicidal ideation). Items are rated on an 8-point scale from infrequent in occurrence to high in frequency of occurrence. Its validity is based on research in childhood depression and upon its content (Kovacs et al., 1984). Intraclass correlations, a measure of reliability obtained from ratings made by pairs of interviewers on 39 symptoms, averaged 0.78 (range from 0.64 to 1.00) for mental status items, 0.78 for observational items, and 0.77 for clinical impressions. Administrators of this instrument must have considerable clinical expertise as well as specific training in its use.

10.1 Summary/Critique.

In general, structured interviews are somewhat less reliable than other assessment methods such as psychological testing and behavioral ratings. It is perhaps obvious, but necessary to remark, that structured interviews can not be any more reliable than the diagnostic system on which they are based. Their value is that they cover a broad range of childhood psychopathology and are useful in confirming criteria for ADD/ADHD, and most importantly, are invaluable in pinpointing comorbid conditions associated with ADD/ADHD. Edelbrock and Costello (1988) reviewed the structured interviews as developed at that time and wrote as follows:

> "No single interview has emerged as superior for all purposes, and all have strengths and weaknesses. Neither the Child Screening Inventory nor the Mental Health Assessment Form can be recommended for research applications because of low reliability and weak validation. The interview version of the Behavioral Screening Questionnaire has proved useful in screening preschool children for behavioral disorders, but the rating scale version appears equally good and the Preschool Behavior Questionnaire--a paper and pencil scale (Behar, 1977)--has broader symptom coverage, high reliability, strong validation, and good screening efficiency. The Child Assessment Schedule can be tentatively recommended as a descriptive tool, particularly because of the recent addition of a parallel form for parents...However, it has a narrower age range, symptom coverage, and diagnostic range than measures such as the DISC and DICA, and the reliability of CAS diagnoses has not been established.
>
> The remaining four interview schedules [of the ones they reviewed] can be recommended for specialized purposes. The K-SADS and the Interview Schedule for Children were developed to select subjects for research on child depression. Their symptom coverage is much more comprehensive in the area of affective disorders than in other disorders...
>
> ...the DICA and the DISC are quite opposite to the K-SADS and ISC. They are very highly structured diagnostic interviews designed primarily for epidemiologic surveys of nonreferred populations. They do not have a particular diagnostic focus, but cover an extremely broad range of child behaviors, symptoms, and events...both the DICA and

DISC can be recommended as descriptive and epidemiological tools. They seem best suited to screening and identification of children at risk for psychiatric disorder and for producing 'best estimate' diagnoses in survey studies" (pp. 108-109).

We would only add that both the DICA and the DISC have been used to make DSM-III diagnoses in both research and clinical studies (Dykman et al., 1992, Gilger et al. 1992; Gillis et al, 1992, Livingston et al, 1992; Stevenson et al. in press). Various versions of the DISC have been used in the field trials to establish the revised definitions of ADD/ADHD which will appear in DSM-IV (see Section 3.0).

11.0 Psychoeducational Assessment.

One of the very best instruments to assess intelligence in elementary school children with a diagnosis of ADD/ADHD is the WISC-R or the newer revision, WISC III. Other versions of the WISC, also excellent, are available for preschool and older youth and these will not be discussed here. The WISC-R provides two IQ measures one called Verbal IQ and the other Performance IQ. Full scale IQ is a weighted average of Verbal and Performance IQ. The verbal scale of the WISC-R is composed of six subtests: Vocabulary, Information, Similarities (e.g., in what way are two objects alike), Arithmetic, Comprehension, and Digit Span. The performance scale also has six subtests: Picture Completion, Picture Arrangement, Block Design, Coding, Object Assembly, and Mazes. Digit Span and Mazes are not, however, included in the computation of IQ scores.

Factor analyses of the WISC-R indicate that it measures three relatively independent aspects or dimensions of intelligence (Ackerman et al, 1976; Rugel, 1974a, 1974b, Bannatyne, 1974, Kaufman, 1979): verbal comprehension (Comprehension, Similarities, Vocabulary, and sometimes Information), perceptual organization (Picture Completion, Block Design, Object Assembly, and sometimes Mazes), and freedom from distractibility (Arithmetic, Digit Span, Coding, and sometimes information). The WISC III contains verbal scales with the same names as those on the WISC-R, but they have been revised. There is one completely new performance test called Symbol Search. This subtest (combined with coding) is said to measure a 4th dimension of cognitive ability called Processing Speed; i.e, the WISC III adds an additional factor to the original three found on the WISC-R.

Pennington et al. (in press) compared Reading Disabled (RD), ADHD, ADHD+RD, and control children on these three factors. There was no significant differences between the groups for Verbal Comprehension. However, the Perceptual Organization factor score was significantly higher for the two RD groups than for the other groups. The three clinical groups tended to have lower scores than the controls on the freedom from distractibility factor, but the difference was not statistically significant. Higher full scale IQ was associated with better performance on a phonological processing test and on measures of executive function (see below).

There are number of other excellent individually administered tests assessing intellectual functioning that can be used by persons examining ADD/ADHD children including the fourth edition of the Stanford Binet, published in 1985 with a revision based on six to eight years of work (Thorndike et al. Riverside Publishing Co.). It purports to measure intelligence from age 2 to adulthood. There are 15 subtests: 3 to 4 tests in each of 3 broader categories (Verbal Reasoning, Abstract/Visual reasoning, and Quantitative Reasoning), and 3 Short-Term Memory tests. Other tests that are sometimes used are the Peabody Picture Vocabulary Test (PPVT-R)and the Kaufman Brief Intelligence Test (when one wants a reliable and quick evaluation).

Turning to achievement tests, the one most widely used in clinical studies is the Wide Range Achievement Test (WRAT). It has been used in a great number of studies and is supported by excellent reliability and validity data. Nationally standardized normative data are available for three age ranges in reading (word recognition, which is very important in identifying RD children), spelling, and arithmetic. A promising test for assessing RD in ADD/ADHD subjects is the latest revision of the Gray Oral Reading Test (Weiderholt and Bryant, 1992, Slosson Educational Publications). It consists of four subtests: General Vocabulary, Syntactic Similarities (understanding similar but syntactically different sentences), Paragraph Reading, and Sentence Sequencing (ability to build plausible relations among sentences). Earlier versions of the Gray have been widely used.

The Kaufman Assessment Battery for Children (K-ABC) provides a more extensive coverage of achievement than the above tests. It also measures intelligence but separately from achievement. It includes 16 subtests and the achievement scale covers Expressive Vocabulary, Faces and Places, Arithmetic, Riddles, Reading/Decoding, and Reading/Understanding. It purports to measure skills in reading and arithmetic. The K-ABC was designed to reduce cultural bias and its reliability and validity are supported by numerous research studies. Kaufman has also developed strict achievement test assessing mathematics, reading, and spelling, i.e, the Kaufman Test of Educational Achievement (K-TEA). It is stated that this test meets the requirements for LD set forth by P.L. 99-457.

A number of achievement tests that have been published by Woodcock et al. are also very good. These include the Woodcock Reading Mastery Test-Revised, which provides an excellent coverage of basic reading skills, and the more global achievement test, the Woodcock-Johnson Psychoeducational Battery-Revised (WJ-R). The latter is designed to provide examiners with assessment of cognitive abilities and achievement in preschool or low-functioning subjects (Woodcock and Johnson, 1991). The test gives a very broad coverage of cognitive skills for ages 2-90+ including an assessment of all basic school subjects. Another very good test is the Revised Peabody Individual Achievement Test (PIAT-R) which may be obtained from the American Guidance Service, P.O. Box 99, Circle Pines, MN 55014-1796.

11.1 Summary/Critique.

It is obvious that any person assessing an ADD/ADHD children should incorporate as a minimum achievement and IQ tests. Below, we give a summary of tests from which a clinician might choose in studying the characteristics of ADD/ADHD children.

1) Wechsler Intelligence Scale for Children-Revised or the newer WISC-III.
2) Stanford-Binet Scales of Intelligence-Revised.
3) Wechsler PreSchool and Primary Scales of Intelligence-Revised.
4) One of the short form intelligence tests described above (e.g, Slosson), particularly if the interest is in verbal intelligence, which is an issue when one wants to know whether a child can complete a given laboratory test or give reliable information in an interview.
5) Woodcock-Johnson Psychoeducational Battery.
6) Wide Range Achievement Test-Revised.
7) Gray Oral Reading Test-Revised.

If one wanted a generalized score of reading achievement, he/she might convert the scores on each of 4 or 5 tests to z-scores, and then average these to obtain a composite or mean score for each child.

If a learning disability is documented, an examiner should also include measures of language, memory, and development, and some of the possible tests that might be used are listed below:

Language Measures.

1) Colorado Pig Latin Test (Olson et al., 1989, Pennington, 1991)
2) Token Test (DeRenzi, E; Vignola, L.A., 1962)
3) Word Fluency (Levin et al., 1991)
4) Rapid Automatized Naming (Denckla, M.B. & Rudel, R., 1976; Wolf, M., 1991)
5) Boston Naming Task (Kaplan et al., 1983)

Memory Measures.

1) Wechsler Memory Scale-revised (Psychological Corporation, 1993 catalog.)
2) Word List Learning (Taylor, E.M., 1959; Lezak, M.D., 1976)
3) Selective Reminding Test (Weingartner et al., 1979)
4) California Verbal Learning Test (Levin et al., 1991; Psychological Corporation, 1992 catalog.)

Developmental Assessment.

1) Minnesota Child Development Inventory (American Guidance Service, 1992 catalog.)
2) Developmental Activities Screening Inventory - II, Pro-Ed., 1992 catalog.)

12.0 Neuropsychological Assessment

There is no intent here to cover in any detail neuropsychological tests or studies that have been done on ADHD children. Here we mention only some tests that have proven useful in separating ADD/ADHD children from children with Reading Disabilities. Pennington et al. (in press) and Denckla (in press) emphasize the importance of executive function in assessing children with developmental disabilities. Stuss and Benson (1987) speak of executive aspects of attention, saying that attention includes top-down psychological processes, i.e., specific processes controlled by the cortex. Denckla suggests:

> "A simplification of terminology might have it that executive function refers to attention not only to the present but also the future, as well as intention (preparedness to act). Thus defined, executive function is clearly a higher-order "top-down" domain" (p.2)...

Prefrontal cortex has been thought to be of primary importance in the mediation of executive function (Welsh et al., 1991; Dennis, 1991; and Gnys and Willis, 1991). Striatal regions may also be important (Voeller, 1991; Denckla, 1991), including more remote regions of the cerebellum that are known to be motorically in partnership with the frontal lobes (Raichle, 1992; and Denckla, in press).

Executive function is assessed with tests such as the Tower of Hanoi and the Wisconsin Card Sorting Task. Executive function refers to functions such as planning, set-shifting ability, impulse control, sustained attention, and working memory (Welsh et al., 1991). The Tower of Hanoi (Simon, 1975) evaluates the ability of a subject to plan and execute a sequence of moves to achieve a designated end. Planning behavior has been reported to be defective in frontal-lobe-damaged adults. The primary response measure from the Wisconsin Card Sorting Test is **perseverative errors**, defined as responses made in a previous task which carry over to the present task. Welsh et al. (1991) claim that

perseverations on the Wisconsin Test, under standard conditions of administration, are not correlated with IQ.

Executive function has also been construed to include working memory (Goldman-Rakic, 1987). Working memory is the memory one needs to carry out everyday activities. According to Pennington (in press), it is prospective in nature rather than retrospective, and this makes it different from short term memory, which is transient (e.g, as measured by digit span), and long term memory, which is relatively permanent. Working memory is involved in reading comprehension in that it requires one to relate past text to present text and these in turn to events stored both in short and long term memory. The recall from memory is by necessity highly selective. Working memory is also involved in mental arithmetic such as on the WISC. As a further example, Pennington sees working memory as tapped by the A-X procedure of the continuous performance test. In this paradigm, a subject is required to respond to an X if and only if it is preceded by an A and to inhibit responses to all other letters including X alone or A alone. It is presumably the inhibition of competing responses that requires executive function mediated by the prefrontal cortex.

"Frontal lobe functions" as measured by the Tower of Hanoi and the Wisconsin Test are known to be impaired in early-treated phenylketonuria (Welsh et al. 1991) and in other developmental disabilities. Pennington et al. (in press) reported that impairment of executive function occurs in ADD/ADHD children but not in reading disabled (RD) children and, most importantly, not in children who are both RD and ADD/ADHD. At the same time, the pure ADD/ADHD group was found not to be deficient in phonological processing as assessed by Pig Latin fluency and the Word Attack subtest of the Woodcock Johnson. In sum, and this study needs to be replicated, children who are both ADHD and RD are more like RD children than they are like ADHD only children.

A variety of verbal fluency tests have been used to assess executive function, one dimension of working memory. All are time limited and require a subject to retrieve specific words as prescribed by some information; e.g., all words that begin with an d. Welsh et al. (1991) have utilized four categories (food, clothing, animals, and things to ride) from the McCarthy Scales for Children's abilities (1972). They allowed 40 seconds of retrieval for each category and obtained a total verbal fluency score by summing across the four categories. The fluency scores were not significantly correlated with verbal IQ and improved, as one might expect, with age. Another relatively common measure of verbal fluency is the Controlled Word-Association Test of Benton and Hamsher (Levin et al., 1991). In this test, the subject is allowed one-minute to recite words beginning with each of several specified letters of the alphabet.

Figural (Design) Fluency has also been used to assess executive function (Levin et al., 1991). Levin et al. (1991) asked children to draw as many nonsense designs as possible in time periods of three minutes, first under free conditions, and then under fixed conditions (use four lines). There are two scores, perseverative errors and total correct productions. Apparently, Figural Fluency is not correlated with Verbal Fluency or with motor speed (Ruff et al., 1987; Vik and Ruff, 1988).

Another recently used measure of executive function is what Denckla (in press) refers to as multitrial verbal (word-list) learning exemplified by the California Verbal Learning Test (CVLT) or by one of the Selective Reminding Tests. There are several versions of the latter, and in all of them the subject is given a supra-span list of words to remember (Clodfelter et al., 1987). On each trial, he is reminded of the ones he failed to recall. The CVLT is a five-trial learning of 15 items (items spoken by the examiner), followed by a distractor list similarly presented, and then after a short delay by free- and cued-recall and a recognition trial. Levin et al., (1991) used this test in their investigation of executive function. Memorization involves executive function in the sense that it calls into play working memory,

encoding strategies, and retrieval strategies (Welsh et al, 1991; Pennington et al., in press). So the emphasis is not on contents of memory that have been stored in the past but on the incorporation of new information into a usable form in short or long term memory depending upon the need. Felton and Wood (1989) used the Rey Auditory Verbal Learning Task (RAVLT) and Rapid Automatized Naming (RAN) to separate ADD and RD children; the ADD group were poor on the RAVLT and the RD children were poor on the naming task.

12.1 Summary/Critique

There are many writers who believe that frontal lobe functions play a very important role in ADD/ADHD behavior (see Section 5), and these are best assessed by those tests that have been used to examine executive function. At the same time, it is important to include neuropsychological measures which tap language and reading skills as discussed in the previous section. Both sets of measures are important in examining children who have combined attentional and reading problems. Some possible tests that might be used in combination with those listed in the previous section follow:

A) Executive Functioning.
1) Wisconsin Card Sorting Task
2) Tower of Hanoi
3) Stroop-Color Word Test (Golden, 1987)
4) Word Fluency
5) Cancellation of target figures.
6) Continuous Performance Test (A-X type of paradigm).
7) California Verbal Learning Test or one of the versions of the Selective Reminding Tests.

B) Visual Spatial Functioning.
1) Judgement of line orientation
2) Bender Visual Motor Gestalt Test
3) Facial Recognition

C) Speech-Emotional Functioning.
1) Affective Prosody
2) Test of Facial Affect Recognition

13.0 Neurological Assessment.

There have been a number of studies suggesting that ADD/ADHD and LD children have an inordinate number of soft or hard neurological signs relative to normal control children. There is no sharp distinction between soft and hard signs except that, in general, hard signs are those that are known to occur in well defined neurological diseases. Both kinds of signs point to defects in neural functioning. Shaywitz and Shaywitz (1988) summarize much of the literature in this area in the following way.

> "...from time to time, the findings of minor neurologic abnormalities have been used to indicate pathogenesis, with some clinicians equating these findings with the diagnosis of brain damage or organicity, and others interpreting these signs as merely suggesting brain dysfunction...However, both the theoretical and the practical limitations of such an approach are well recognized.

The choreiform syndrome, which emerged in the 1960's, embodies the controversy surrounding the significance of minor neurologic abnormalities. First noted as muscle artifact on the EEG of hyperactive children referred for poor school performance, these irregular, arrhythmic muscle jerks of short duration were termed choreiform movements and related to reading problems and histories of perinatal complications (Prechtl and Dijkstra, 1960; Prechtl and Stemmer, 1962). However, Rutter et al. (1966) were not able to replicate these findings. The relationship between neuromaturational signs and ADD continues to remain controversial. Some investigators (Hart et al., 1974; Lucas et al., 1965; McMahon and Greenberg, 1977; Mikkelsen et al., 1982; Peters et al., 1975) report an increased frequency of soft signs in children with ADD, while others (Camp et al., 1978; Werry and Aman, 1976; Wikler et al., 1970) fail to note any difference. Waber and Mann (1985) report an association between motor overflow and task related performance in normal and fifth grade children. Thus, children with high overflow scores exhibited difficulty in focusing attention, distractibility, and impulsivity...

In practical terms, many investigators and clinicians believe that the significance of a neuromaturational examination (NME) relates to its ability to differentiate groups rather than individual children as either ADD or normal. At present time, it is reasonable to suggest inclusion of such aspects of the neuromaturational examination as finger agnosia, laterality, and fine motor function, including rapid sequential finger tapping, synkinesis, and figure drawing (Shaywitz et al., 1984). However, examination of such gross motor function as balance during passive stance, heel or toe-walking, or any of the gross motor items on the Lincoln-Oseretsky test (Stott, 1966) does not appear to be useful in the diagnosis of ADD (Colligan, 1981)" (pp426-27).

The Peters et al. (1975) neurological examination, designed in the sixties specifically to study MBD (hyperactive and LD), was first used in a research study in 1973. It was found that hyperactive and LD children differed from normal children on most items on the examination. Dykman (Dykman et al. 1971) factor analyzed the neurological examination of Dr. Peters and found 14 oblique (correlated) factors:

1.) Fine coordination, upper limbs.
2.) Fine coordination, lower extremities.
3.) Gross coordination, upper extremities.
4.) Gross coordination, lower extremities.
5.) Reflexes and thresholds.
6.) Right-left confusion.
7.) Mixed laterality.
8.) Tongue control.
9.) Control of facial musculature.
10.) Control of eye muscles.
11.) Dysgraphia and letter reversal.
12.) Dysgraphesthesia and finger agnosia.
13.) Ability to comprehend instructions.
14.) Attention-inattention.

The correlation of the factors was substantial suggesting, in retrospect, a model with one general ("g") factor coupled with several specific and unrelated factors.

Denckla (1985) describes a revision of the Physical and Neurological Examination for Soft Signs (PANESS). This revision was undertaken to eliminate items difficult to administer, score, or lacking in reliability; to eliminate items that occurred infrequently; to add items reported to be highly reliable and characteristic of populations of interest to child psychiatry; to minimize requirements for special equipment; to eliminate sensory items that have little research interest; and to do all of this without lengthening the examination beyond 15 to 20 minutes. The PANESS was originally developed by the National Institutes for Health and it included items for soft signs devised by Abbottt Laboratories.

We found only one study in which PANESS has been used to study ADD/ADHD children. Mikkelsen et al. (1982) studied the neurological status of 30 hyperactive, 40 enuretic, and 22 normal boys with the original PANESS. As might be expected, there was a strong negative correlation between age and the PANESS total score. The age-adjusted mean PANESS score was significantly higher for hyperactive subjects than for the other two groups. Interestingly, PANESS scores correlated significantly with IQ, number of errors on the Bender Gestalt Visual-Motor Test, and with electrocortical activity.

Levine et al. (1988) have developed neurological examinations for use by pediatricians who wish to evaluate a child's functioning in the following areas: memory, attention, language, and motor coordination. Delayed or abnormal performance on these measures can be classified within specific "clusters of dysfunction" which have been shown to be statistically associated with school problems. These examinations are considered by pediatricians to be useful as part of a multidisciplinary assessment.

Recently, Hadders-Algra and Touwen (1992) reported that minor neurological dysfunction (MND) is more closely related to learning difficulties than to behavioral problems. In brief, it was found that the presence and severity of MND on a standard neurological examination designed by Touwen (1979, 1987) were significantly related to poor performance on standardized reading, spelling, and arithmetic tests. And while MND was also related to ratings of destructive behavior on parent and teacher questionnaires, the degree of relationship was less than for the relationship of MND with cognitive variables.

13.1 Summary/Critique.

It appears that there is good reason to continue to look at neurological variables in ADD/ADHD children. We should focus on the development of reliable and valid items, and preferably those which are susceptible to quantitative measurement. This implies a greater use of sophisticated equipment for measuring signs--video cameras, computer tasks, and accurate timing devices.

What needs to be done with all assessment devices (rating scales, neurological exams, etc.) is look at the predictive rate positive for making a diagnosis of ADD/ADHD taking into account the base rate of the disorder. This should be done separately for clinic and community samples.

14.0 Two Significant New Publications.

The CH.A.D.D. (Children with Attention Deficit Disorders) organization has very recently published an "Educators Manual" (Fowler et al. 1992) which covers many of the issues raised above in a very readable form. The manual can be ordered from CASET Associates, 3927 Old Lee Highway, Fairfax, VA 22030 or phone 1-800-545-5583. We would recommend this manual not only for educators but for everyone who is involved with ADD/ADHD children. The writers of this manual propose a two-stage assessment process referred to as tiers: Tier One is "Determining Presence of ADD symptomatology"; Tier Two "Determining Adverse Effect on Performance". The first tier involves a

comprehensive interview with caretakers and teachers, both past and present, to assess the existence of ADD symptoms in different environments as well as medical information that might be associated with ADD. The manual states that to date child behavior rating scales are the best available tools to determine the presence of ADD characteristics and severity. One of the problems with rating scales acknowledged in the manual is that teachers and parents frequently disagree even when rating the same behavior. It is recommended that assessment begin with a broad function scale such as: Child Behavior Checklist, Teacher Report Form and Parent Report Form, by Achenbach and Edelbrock, Conners Parent Rating Scale and Conners Teacher Rating Scale Original Form, by Conners, or the Revised Behavior Problems Checklist, by Quay and Peterson (see our tables above for more information). And then to assess ADD-related symptoms and severity, it is recommended that we use scales specific to ADD such as: ADHD Rating Scale for Parents or Teachers (DuPaul, 1990), Home Situations Questionnaire as revised by DuPaul and Barkley (1990), School Situations Questionnaire as revised by DuPaul and Barkley (1990), and the Academic Performance Rating Scale (DuPaul, Rapport, and Perriello 1990). Data gathered in this latter battery are useful for Tier Two. Tier Two involves an assessment of classroom behavior (direct observation over a period of several days by persons other than the teacher), academic productivity relative to a child's IQ (e.g, percentage of work completed and percentage completed correctly during written assignments over 2 week period), and standard psychoeducational tests that, among other things, would help to identify learning problems.

These recommendations are similar to criteria originally recommended by the Professional Group for Attention and Related Disorders (PGARD) except that more emphasis here is placed on medical input to rule out treatable conditions that might be associated with ADD and to provide medication advice. It is felt that this will avoid the problems which arise from schools making recommendations for medication therapy.

Pelham (1992) has published a workshop manual entitled Attention Deficit Hyperactivity Disorder: Diagnosis, Nature, Etiology, and Treatment (for information write Dr. William E. Pelham, Western Psychiatric Institute and Clinic, University of Pittsburgh Medical Center). The manual lists several assessment scales (Disruptive Behavior Disorders Structured Parent Interview, Oppositional Defiant Disorder Symptoms, Iowa/Conners Abbreviated Teacher Rating Scale, Parent-Teacher Disruptive Behavior Disorder Rating Scale, Narrative Description of Child by Parent, Narrative Description of Child by Teacher). Pelham and his associates (Atkins et al. 1985, 1989, 1990; Atkins and Pelham, 1991) have often emphasized the importance of multiple school measures as important in both assessment and treatment (teacher ratings, classroom observation, scoring of daily academic work, and organization of desk).

15.0 Recommendation for Assessment: A Summary.

The child suspected of having ADD/ADHD should be referred to a child specialist (school counselor, school examiner, psychological examiner, pediatrician, psychologist, child psychiatrist) for a thorough clinical evaluation. Any tentative clinical diagnosis made by the child specialist in interviewing the child/youth and his/her parents/caregivers should be backed up with a detailed family and developmental history.

To further rule ADHD as a possibility, the child specialist should first ask parents and teachers to complete a brief rating scale (Conners HI/Abbreviated Scale or ADHD scale of DuPaul). The examiner should note whether the problems are in the area of inattention - restlessness or impulsivity - hyperactivity. The DuPaul scale has norms for children 6-12 so that in this age range one can classify

a child not only as suspect for ADHD but also make a preliminary assessment of hypoactivity or passivity.

A medical examination should be done to check for hearing and vision including visual tracking and convergence. The examination should cover various comorbid medical conditions that might explain the problems the child is having such as hyperthyroidism, allergies, infections, and pinworms (see section 5.5).

Next, the child specialist should obtain more detailed ratings of parents and teachers using one of the following: Achenbach CBCL, BASC, or the Conners PQ-93 and TQ-39. If these more detailed reports confirm first stage diagnostic impressions, structured interviews should be completed, both a self-report form and a parent form, and the child should be observed in the classroom, if possible. Also, the child should be given individually administered intelligence and achievement tests as described in Section 11. We would also recommend a neuropsychological and neurological evaluation, as discussed in Sections 12 and 13. Then, the various people involved in assessment should get together to evaluate all information.

Whether a diagnostic label is or is not assigned will depend upon whether it is necessary for reporting purposes of for the purpose of obtaining help for the child. The important thing is to describe the problems of the child, areas in which he is deviant from his peers, and to formulate a treatment plan which directly deals with the characteristics and problems of the child.

Proper assessment has direct consequences for prescribing treatment. For example, we sometimes see children with Anxiety Disorder who have been placed on stimulant medication because of inattentive behavior at school. While methylphenidate has certain positive effects in even normal children, this should not be the first treatment for children with an Anxiety Disorder. In this case, the treatment proposed will further confound and confuse the diagnosis of the primary disorder (i.e., Anxiety Disorder).

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